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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey, MS 421
Reston, VA 22092

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Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

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SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

STUDY OF DRAINAGE BASIN LINEARITY AND NON-LINEARITY,
National Technical Univ., Athens (Greece). Dept. of Civil Engineering.
M. Mimikou.
Journal of Hydrology, Vol. 64, No. 1/4, p 113-134, July, 1983. 12 Fig, 2 Tab, 8 Ref.

Descriptors: *Catchment areas, *Discharge hydrographs, Discharge measurement, Drainage, Runoff, Rainfall-runoff relationships, Storm runoff, Flood peak.

Three peak discharge distributions are estimated for eight drainage basins between 200 and 6000 sq km in northern and western Greece. They are found to be similar to the ones obtained in the United States. The distribution slopes have no geographic, climatic or basin morphological influence and their coefficients of determination are linearly related to the degree of hydrologic non-linearity. Only the original peak discharge distribution is necessary and quite sufficient by itself for checking basin hydrologic linearity and accurately predicting peak discharges. Its slope, equal to 1.0 for linear and less than 1.0 for non-linear basins, is a criterion indicating with its magnitude the degree of basin hydrologic non-linearity. Hydrologic design requires identification of the degree of basin hydrologic non-linearity prior to applying linear design methods. The latter's application to non-linear basins can result in serious design errors. The variation in the peak discharge distribution's intercept is significantly explained by the log of any of the two basin morphological indices AS/L and A/L, with A the drainage area, and L and S the main course length and average bedslope of the river, respectively. The prediction of the intercept facilitates the distribution estimation in the region. (Baker-IVI)
W84-02204

GREAT LAKE BASINS (U.S.A.-CANADA) RUNOFF MODELING,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II.
Journal of Hydrology, Vol. 64, No. 1/4, p 135-158, July, 1983. 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, Hydrologic models, Snowmelt, Evapotranspiration, Soil water, Mass balance, Mathematical models, Great Lakes, Lakes, Basins, Genessee River Basin, New York, Canada.

An interdependent tank-cascade model that uses a mass balance coupled with linear reservoir concepts for estimating basin runoff to the Great Lakes for use in routing determinations and operational hydrology studies is described. It is physically based and uses climatological considerations not possible for small watersheds. It employs analytical solutions to bypass numerical inaccuracies. Snowmelt and net supply computations are separable from the mass balance determinations and are based on a simple heat balance. Partial area concepts are used to determine infiltration and surface runoff. Losses are determined from joint consideration of available energy for evapotranspiration and of available moisture in the soil horizons by using climatologic concepts. Also described are heuristic calibration procedures that give insight into the use of the model. The model is applied, for a 30 day computation interval, to the Genessee River Basin in New York State and compared with past 6 hr computation interval applications of the Streamflow Synthesis and Reservoir Regulation and National Weather Service Hydrologic models to the same data set. (Baker-IVI)
W84-02205

MODELLING OF HYDROLOGIC PROCESSES IN A SMALL NATURAL HILLSLOPE BASIN, BASED ON THE SYNTHESIS OF PARTIAL HYDROLOGICAL RELATIONSHIPS,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
Y. Ando, K. Musiake, and Y. Takahasi.
Journal of Hydrology, Vol. 64, No. 1/4, p 311-337, July, 1983. 21 Fig, 6 Tab, 13 Ref.

Descriptors: *Hydrologic models, *Runoff, Groundwater recharge, Runoff, Groundwater runoff, Precipitation, Slopes, Soil water, Evapotranspiration, Basins, Drainage area, Aquifer recharge, Tama Hills, Tokyo, Japan.

A natural small experimental basin, with a catchment area of 4.4 ha was established in the Tama Hills in the western suburbs of Tokyo, Japan. It has not only precipitation and streamflow gauging but also soil moisture measuring instruments and groundwater observation wells. At first, based upon the observed data, the partial hydrologic processes such as direct runoff, rainfall-loss, groundwater runoff, groundwater recharge, and evapotranspiration were analyzed. Then a daily hydrological model and an hourly hydrological model were constructed by synthesizing the results of the above analysis, and their applicability was examined. Bottom-lands such as swamps and ponds acted as contributing areas to direct runoff and hilltops and hillslopes did not contribute directly to runoff because of their high infiltration capacity. Groundwater runoff derived from the unconfined aquifer and was in proportion to the second power of groundwater storage. Groundwater recharge was in proportion to soil moisture excess. While the study clarified the hydrologic processes in both surface and subsurface areas of a natural hillslope basin, the models constructed are felt to be unique to the humid high infiltration capacity area. (Baker-IVI)
W84-02213

TANK MODEL IN RAINFALL-RUNOFF MODELLING,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phen, and P. S. S. Pradhan.
Water South Africa, Vol. 9, No. 3, p 93-102, July, 1983. 11 Fig, 5 Tab, 10 Ref.

Descriptors: *Rainfall-runoff relationship, *Model studies, Watersheds, Tank model, Rainfall, Thailand, Runoff, Storm runoff.

Having a simple structure, the Tank Model has been widely used in modelling the rainfall-runoff processes of many watersheds. In most cases, a daily input and output basis was employed as it was intended originally. In this study, both daily and monthly inputs and outputs were used, and an attempt is made to describe the important related factors and to classify the parameters involved into two types. The parameters of the first type can be obtained by means of an automatic calibration while those of the second type are adjusted by trial and error procedure. Application of the model of two watersheds in Thailand, one small and the other relatively large, shows that the Tank Model can simulate the discharge volume satisfactorily, but is not capable of simulating daily or monthly peaks. This finding holds for both cases, namely when input and output are daily and monthly values. Moreover, the contribution of evaporation is found to be less significant in producing monthly discharges. (Author's abstract)
W84-02309

WORLD WATER AND HEAT BALANCE AND HEAT AND MOISTURE CYCLE ON THE EARTH,
V. S. Mezentsev.
Water Resources, Vol. 9, No. 3, p 238-247, May-June, 1982. 7 Tab, 6 Ref. Translated from Vodnye Resursy, No. 3, p 29-38, May-June, 1982.

Descriptors: *Climates, *Heat balance, *Hydrologic budget, Climatology, Moisture profiles, Oceans, Geological history, Glaciers.

It is hypothesized that during the last 8000 years a complete balance of the heat and moisture resources should have been observed on the land area of the earth and on the surface of the World Ocean. Disturbance of this balance inevitably entails the formation of a global tendency of change in climatic conditions toward aridity or humidity. During the period under consideration there were comparatively brief variations of climate, more than once being characterized by the advance and retreat of mountain glaciers. THis hypothesis was used as the basis for solving the problem of the heat and water balance of the ocean, land, and entire surface of the earth. To this end information is provided on the water balance of the world's largest river basins; components of the water and heat balance on continents, oceans, and earth; components of the moisture cycle in the earth's atmosphere; radiation and heat balance of the earth's surface; radiation and heat balances of the earth's atmosphere, heat balance of the climate of continents and the earth; and variations of components of the balance in years of different probability. Negligible changes in the quantitative characteristics of the climate of the ocean, land, and earth's surface as a whole of probability 25 or 75% and having the same trends over a sufficiently long time period lead to impressive (in extent and depth) changes in the climatic conditions of the earth. Such unequivocal trend variations of the climate are related to rearrangement of the circulation processes in the hydrosphere and atmosphere leading to disturbances of the complete balance of heat and moisture resources. Structural changes occurring in the earth's crust are the cause of this rearrangment. (Baker-IVI)
W84-02313

TRENDS IN THE VARIATION OF SURFACE WATERS OF THE HYDROSPHERE,
R. K. Klige.
Water Resources, Vol. 9, No. 3, p 272-284, May-June, 1982. 5 Fig, 4 Tab, 40 Ref. Translated from Vodnye Resursy, No. 3, p 92-105, May-June, 1982.

Descriptors: *Hydrologic budget, *Surface water, Variability, Water exchange, Climates, Water resources, Heat balance.

An analysis of the main directions of investigations of the hydrosphere and water exchange indicates the need for a combined examination of processes occurring in the atmosphere, hydrosphere, and lithosphere. A study of the processes for formation and development of the hydrosphere and determination of the regularities inherent to these processes can serve as the basis of a superlong-range forecast of the state of the earth's water resources. Modeling of the relief and hydrosphere permits the assumption that, as a result of continuing planetary development of the earth during the next billion years, the volume of the water mass of the World Ocean will increase by about 6-7% which can lead to an increase of its average depth of 1 km. The area of the ocean will decrease by about 16% due to continuing downwarping of the bottom and uplifting of continental blocks. The long-term variations of ocean level in the current century were due primarily to changes in the system of global water balance, which are closely related to the change in thermal conditions. Therefore, a rise of the ocean level occurred simultaneously with warming of the climate on the plant with approximately a 19-year lag of the level relative to the temperature change. An analysis of the dynamics and components of the balance of global water exchange showed their closest relation to the change in the heat balance on the earth's surface. When the heat income increases due to a rise of air temperature an increase of all components of the water balance, as a rule, is observed, which indicates intensification of water exchange. This pertains especially to evaporation and precipitation over the ocean surface. (Baker-IVI)
W84-02316

ESTIMATION OF THE VOLUME OF REGENERATED WATER OF THE CONTINENTAL CRUST IN GLOBAL WATER EXCHANGE,
O. M. Rozen.
Water Resources, Vol. 9, No. 3, p 285-297, May-June, 1982. 4 Fig, 6 Tab, 50 Ref. Translated from Vodnye Resursy, No. 3, p 106-118, May-June, 1982.

Descriptors: *Water exchange, *Water resources, *Regenerated water, Continental crust, Salinity, Geohydrology, Geologic history.

An attempt is made to estimate the balance of buried water and water released from volcanogenic-sedimentary rocks during the formation of the earth's crust, which is particularly important for studying the paleohydrology of the earth and for control, to estimate the portion of chlorine in the regenerated fluid, since this index will determine the salinity of regenerated water. Bulging up of granitoids and orogeny, leading to the geologically instantaneous supply of a large amount of terrigenous material to the ocean, are an important accompanying consequence of global epochs of metamorphism. The combination of an increase of the volume of water and its displacement by the incoming terrigenous sediments should have led to an increase of its level and to transgressions. Taking into account the large volumes of rocks in Early Precambrian deposits and the intensity of metamorphism, which often reached the granulite facies at that time, it must be assumed that the periodic rises of the World Ocean level were originally quite intense and then gradually decreased. This was probably followed by an epoch of long tectonic calm, shelf sedimentation, and gradual draining of the little submerged parts of continents. In the future it may be possible to estimate these effects quantitatively. (Baker-IVI)
W84-02317

URANIUM DISEQUILIBRIUM AS AN INDICATOR OF PROCESSES IN THE HYDROSPHERE,
P. I. Chalov.
Water Resource, Vol. 9, No. 5, p 466-479, September-October, 1982. 1 Tab, 40 Ref. Translated from Vodnye Resursy, No. 5, p 24-38, September-October, 1982.

Descriptors: *Hydrogeology, *Uranium radioisotopes, *Radioactive tracers, Radioisctopes, Model studies, Hydrology.

The mechanism of natural fractionation of U-234 and U-238, which is somehow related to the formation of lattice defects of natural crystals, should explain fractionation of the isotopes during autooxidation of uranium in microimperfections, the dependence of the degree of fractionation of uranium isotopes on its content and uniformity of distribution in natural formations, the regularity, common for isotopes of radioactive series, of an increase of the excess of daughter isotope in microimperfections with respect to the parent of the radioactive series with increase of the decay constant of the daughter isotope, and various other factors. To arrive at a model of the mechanism of the phenomenon under consideration it was necessary to analyze the causes of occurrence of lattice defects of radioactive minerals. There are considerable possibilities for the new tracer when solving problems of hydrology. In a number of cases this tracer supplements the information obtained by other isotopic and hydrologic methods, but there are problems whose solution is possible practically only by means of uranium disequilibrium. (Baker-IVI)
W84-02326

HYDROGEOCHEMISTRY OF THORIUM ISOTOPES IN THE ZONE OF ACTIVE WATER EXCHANGE,
Moscow State Univ. (USSR).
N. A. Titaeva, V. N. Maslov, A. I. Taskaev, T. I. Veksler, and I. I. Shuktomova.
Water Resources, Vol. 9, No. 5, p 511-516, September-October, 1982. 1 Fig, 4 Tab, 11 Ref. Translated from Vodnye Resursy, No. 5, p 77-82, September-October, 1982.

Descriptors: *Thorium isotopes, *Water exchange, Geochemistry, Isotopes, Path of pollutants, Ural Mountains, USSR.

The behavior of isotopes of thorium in the zone of hypergenesis should be determined by the following factors: concentrations, ratios, forms of occurrence of isotopes in rocks and their resistance to weathering processes; possibilities of transportation and the physicochemical conditions of the transporting medium; physicochemical conditions of fixation of thorium. Two regions of the Northern and Poral Ural Mountains where waters of the zone of active water exchange, surface waters, and the water containing rocks were studied, were selected for investigation. In the northern regions of the humid climatic zone, thorium-enriched waters readily form in the zone of active water exchange in areas of development of crystalline rocks. Dilution of these waters by meteoric waters promotes precipitation of thorium and limits the duration of its water migration. (Baker-IVI)
W84-02329

NUMERICAL SOLUTION OF THE PROBLEM OF INTERACTION OF SURFACE AND SUBSURFACE WATERS,
V. V. Badov, and A. A. Kiselev.
Water Resources, Vol. 10, No. 1, p 28-41, January-February, 1983. 6 Fig, 1 Tab, 14 Ref. Translated from Vodnye Resursy, No. 1, p 66-80, January-February, 1983.

Descriptors: *Surface waters, *Groundwater, *Surface-groundwater relations, Mathematical models, Model studies, Soil-water-plant relationships, Groundwater recharge, Seepage, Soil water, Flow, Hydrologic budget.

The established ideas about the unity and continuity of the movements of water in the atmosphere, on the ground surface, in rocks, and in plant tissues are the premises for creating a generalized mathematical model of the interaction of surface and subsurface waters. A solution is proposed to the mixed internal boundary-value problem for a quasilinear partial differential equation describing the combined unsteady flow of groundwaters and moisture of the zone of aeration in a two-dimensional piecewise-homogeneous profile-plant region on the contours of which can be assigned boundary conditions approximating regime-forming factors. The advantages of the proposed method of studying the interaction of surface and subsurface water compared to the water balance method become obvious when one takes into account that all components of the water balance are expressed in terms of discharge and each of them requires determination by an independent method. (Baker-IVI)
W84-02344

SIGNIFICANCE OF RAINFALL IN THE STUDY OF HYDROLOGICAL PROCESSES AT BASIN SCALE,
Birmingham Univ., (England). Dept. of Civil Engineering.
M. J. Hamlin.
Journal of Hydrology, Vol. 65, No. 1-3, p 73-94, August, 1983. 11 Fig, 5 Tab, 29 Ref.

Descriptors: *Rainfall, *Basins, Watersheds, Model studies, Rainfall distribution, Runoff, Storms, Hydrology.

Precipitation is one of the most variable of the hydrologic processes, raising two problems when studying hydrological processes of basin scale. The first problem is the extent to which the areal rainfall distribution can be determined from point measurements and the second is the degree to which errors in the assessment of true catchment rainfall affect the decision outcome. Three empirical studies focusing on these particular problems are presented. For smaller catchments, where different individual processes may be dominant under different conditions, the variation in rainfall is of fundamental importance. For example, when considering the contributing area concept of catchment runoff it is more important to know the rainfall intensity over the contributing area than the average intensity over the whole catchment. For many large catchments the general averaging which takes place balances out any significant variations both in the catchment processes themselves and in the rainfall inputs. Thus for catchments of 40,000 sq km the monthly mean catchment rainfall may be a perfectly adequate input for the modelling of the catchment output without any need to model or understand individual processes within the basin. (Baker-IVI)
W84-02441

FORMULATION OF AN ANALYTICAL APPROACH TO HYDROLOGIC RESPONSE AND SIMILARITY AT THE BASIN SCALE,
Mississippi Univ., University. Dept. of Civil Engineering.
V. K. Gupta, and E. Waymire.
Journal of Hydrology, Vol. 65, No. 1-3, p 95-123, August, 1983. 3 Fig, 3 Tab, 30 Ref. NSF grant ENG-CME 7907793.

Descriptors: *Open channels, *River basins, Hydrology, Hydrologic models, Water transport, Geomorphology, Networks.

The hydrologic response at the basin scale represents the temporally and spatially averaged behavior of water transport in a channel network. Some theoretical studies have recently appeared in the literature which attempt to formulate and solve the problem of how the averaging of the network geometry and the dynamics determines the hydrologic response. A brief critical review is offered of some earlier attempts made to develop mathematical formulations for determining the structure of the hydrologic response at the basin scale. An enumeration is given of the basic mathematical elements of a model for approaching the problem of basin scale hydrology. Some preliminary ideas on the notion of hydrologic similarity are developed, and some general observations about the nature of goals in the direction of understanding the physical problems at the basin scale are offered. The key variables of a channel network that determine its response function are identified. (Baker-IVI)
W84-02442

LAKE ONTARIO BASIN (U.S.A.-CANADA) RUNOFF MODELING,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. E. Croley, II.
Journal of Hydrology, Vol. 66, No. 1-4, p 101-121, October, 1983. 4 Fig, 9 Tab, 10 Ref.

Descriptors: *Runoff, *Model studies, *Lake basins, *Lake Ontario, Canada, New York, Infiltration, Evapotranspiration, Snowmelt, Tank-cascade models, Climatology, Watersheds, Basins.

An interdependent tank-cascade model of basin runoff is described. The model employs analytical solutions of climatological considerations relevant for large watersheds. The mass balance is coupled with physically-based concepts of linear reservoir storages, partial-area infiltration, complementary evapotranspiration and evapotranspiration opportunity based on available supply and heat-balance determinations of snowmelt and net supply. Daily air temperature, precipitation and runoff data are needed for calibration of the nine parameters; data are grouped for 15 watersheds about Lake Ontario as well as for the entire basin above Elevator, New York and Kingston, Ontario. The model is applied to the Lake Ontario Basin in both lumped- and distributed-parameter approaches. Eleven subbasins and two basins are modeled for 7- and 30-day mass balance computation intervals. Parameter values are interpreted for physical meaning and relation to data errors and computation intervals. Temporal and spatial integration effects are analyzed with respect to error reduction, modelling information and resolution, and cost trade-offs. Result summaries are given depicting model applications and validity. The model is an accurate, fast representation of weekly or monthly runoff volumes from large watersheds with simple calibration and daily requirements. Parameters values have physical significance and appear reasonable and consistent. (Baker-IVI)
W84-02460

TIME-VARIANT NONLINEAR FUNCTIONAL RUNOFF MODEL FOR REAL-TIME FORECASTING,
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
G. G. Patry, and M. A. Marino.
Journal of Hydrology, Vol. 66, No. 1-4, p 227-244, October, 1983. 8 Fig, 4 Tab, 24 Ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Forecasting, Rainfall, Mathematical studies.

A time-variant nonlinear functional runoff model based on a Volterra-Wiener series representation is presented for real-time runoff forecasting purposes. Using parameter vectors based on actual rainfall-runoff responses, it is shown that the recursive least-squares (RLS) and recursive extended least-squares (RELS) algorithms can provide accurate and consistent parameter estimates under a variety of noise conditions. Rainfall-runoff relationships characterized by a low signal to noise ratio result in less stable and less accurate parameter estimates. Finally, from a practical point of view, the proposed model offers the possibility of tracking in real-time slow variations in rainfall-runoff response brought about by changes in moisture conditions, evapotranspiration rates or any other factor that would tend to slowly modify the rainfall-runoff response of a catchment. (Baker-IVI)
W84-02468

2B. Precipitation

METEOROLOGICAL ASPECTS OF THE EL NINO/SOUTHERN OSCILLATION,
National Weather Service, Washington, DC. Climate Analysis Center.
E. M. Rasmusson, and J. M. Wallace.
Science, Vol. 222, No. 4629 p 1195-1202, 16 December, 1983. 6 Fig, 34 Ref.

Descriptors: *Climate, *El Nino, *Ocean surface temperatures, Rainfall, Drought, Snow, Storms, Weather, Monsoons, Seasonal variation.

The single most prominent signal in year-to-year climate variability is the Southern Oscillation, which is associated with fluctuations in atmospheric pressure at sea level in the tropics, monsoon rainfall, and wintertime circulation over North America and other parts of the extratropics. The past 18 months have been characterized by what is probably the most pronounced and certainly the best-documented El Nino/Southern Oscillation episode of the past century. It resulted in severe droughts in Indonesia, eastern Australia, Melanesia, southern India, Sri Lanka, and southern Africa, and extreme rainfall in Ecuador, northern Peru, and the central Pacific. In the United States, there were an unusual number of winter storms that brought flooding to parts of California and the Gulf states, and buried mountain regions of the Southwest with heavy snow in late winter and spring. In this review meteorological aspects of the time history of the 1982-1983 episode are described and compared with a composite based on six previous events between 1950 and 1975. The peculiar time history of the 1982-1983 episode invites speculation as to whether all such episodes might be viewed as a superposition of two, interrelated kinds of events, which usually occur in combination about 6 mo apart: an enhancement of the mean annual cycle in SST (sea-surface temperature), largely confined to the eastern third of the Pacific; and a broader scale warming of the equatorial Pacific from near the dateline eastward. The 1982-1983 episode can be interpreted as the same events in the reverse sequence. (Moore-IVI)
W84-02139

BASIC STRUCTURE OF DAILY PRECIPITATION SERIES,
George Washington Univ., Washington, DC. School of Engineering and Applied Science.
V. Yevjevich, and T. G. J. Dyer.
Journal of Hydrology, Vol. 64, No. 1/4, p 49-67, July, 1983. 11 Fig, 7 Ref. NSF grant CME-7916817.

Descriptors: *Precipitation, *Stochastic process, Mathematical studies, Probabilistic process, Model studies, Fort Collins, Durango, Colorado, Austin, Texas.

To analyze the structural properties of daily precipitation series, records of three precipitation stations were used: Fort Collins, Colorado, with a total length of series of 69 yr.; Durango, Colorado with a total length of series of 71 yr; and Austin, Texas with 70 yr. Their respective average annual precipitation values are 14.32, 19.02, and 33.02 in, respectively. The major objective of this study was to present an in-depth understanding of series structure. Difficulties in estimation of series parameters and in derivations of inferences from fluctuations within the year of these parameters are particularly emphasized. All parameters of daily precipitation series proved to be periodic within the year (probability of zero precipitation, run-lengths of zero and non-zero values) regardless of whether the sampling variation in the estimated parameters permits or not the inferences on periodicity either by visual inspection or by the statistical inferential techniques available. Periodicity curves were estimated by averaging 365 daily values over intervals of 14, 28, or 61 days. Coefficients of variation, skewness and kurtosis, because of their definitions, show less periodicity than other parameters. It is likely that the accuracy of modeling of daily precipitation series, and of the series that are highly related to them such as runoff, evaporation, infiltration or water quality series, will not be improved until the basic structure of precipitation time series in general, and of their periodicity, intermittency and stochasticity, as well as their interrelationships in particular, are investigated in depth. (Baker-IVI)
W84-02201

RAINFALL INTERSTATION CORRELATION FUNCTIONS; VII. ON NON-MONOTONOUSNESS,
Instituut voor Cultuurtechniek en Waterhuishouding, Wageningen (Netherlands).
Ph. Th. Stol.
Journal of Hydrology, Vol. 64, No. 1/4, p 69-92, July, 1983. 9 Fig, 8 Tab, 55 Ref.

Descriptors: *Spatial distribution, *Rainfall distribution, Storms, Mathematical studies, Forests, Soil moisture, Interstation correlation.

Empirically derived rainfall interstation correlation functions may show the property of non-monotonousness. Besides the maximum correlation at interstation distance D = O, the occurrence of secondary maxima has been reported in the literature. It is thus assumed that this phenomenon is caused by arrays of storm cells or by competing of mesoscale systems that pass the area under investigation. In analytical solutions of rainfall interstation correlation functions, tri-rectangularly shaped storm models have been used to produce a continuous range of different storm models. This range involves peaked, flat and cellular structured storm profiles. The theoretical interstation correlation functions for such a range of models changes in a natural way from never increasing to non-monotonically structured functions. Inter-cell distances then appear as a parameter in the correlation functions. (Baker-IVI)
W84-02202

OXYGEN-ISOTOPIC COMPOSITION OF ARCTIC PRECIPITATION,
R. A. Vaikmaje, and J.-M. K. Punning.
Water Resources, Vol. 9, No. 5, p 490-496, September-October, 1982. 4 Fig, 1 Tab, 6 Ref. Translated from Vodnye Resursy, No. 5, p 52-58, September-October, 1982.

Descriptors: *Precipitation, *Arctic regions, *Oxygen isotopes, Chemistry of precipitation, Evaporation, Atmosphere, Glaciers, Paleoclimatology.

The isotopic composition of precipitation is determined by equilibrium in the system ocean-atmosphere-ocean (or land water bodies). Evaporation and formation of the original isotopic composition of atmospheric moisture, variation of the isotopic composition of the phase left in the atmosphere during migration of air masses, and finally, the formation of the final isotopic composition of precipitation during condensation occur in this cycle. The establishment and analysis of regularities of these processes are of paramount importance when studying atmospheric circulation. The establishment of relations between the isotopic composition of precipitation and climate-forming factors of the environment permits reconstructing the paleoclimatic and paleogeographic conditions on the basis of determining the oxygen isotopic composition variations in vertical glacier profiles. The analysis as performed permits assuming localization of the main source of precipitation in the Atlantic sector of the Arctic Ocean at 60 degrees, within the Icelandic-Kara low. A large contribution of the local water area to the formation of atmospheric moisture is observed everywhere. (Baker-IVI)
W84-02327

DROUGHT-INDUCED CHANGES IN CRAYFISH POPULATIONS ALONG A STREAM CONTINUUM,
Georgia Univ., Athens. Dept. of Zoology.
R. C. Taylor.
American Midland Naturalist, Vol. 110, No. 2, p 286-298, October, 1983. 5 Fig, 2 Tab, 39 Ref.

Descriptors: *Crayfish, *Drought, *Population dynamics, Streams, Georgia, Sandy Creek, Piedmont Plateau, Drainage basins, Aquatic habitats, Reproduction.

Significant variations were noted in crayfish populations in 2nd- and 5th-order streams in NE Georgia between sites within 1 year and between years. The 1st year experienced normal rainfall and the second, a severe drought. Of two crayfish species that inhabit the drainage the burrowing species (Cambarus latimanus) showed no significant changes, whereas the nonburrower (Procambarus spiculifer) exhibited large drought-induced population changes, including reductions in adult population densities, resident densities and body size, an alteration in the reproductive timing and an increase in the number of juveniles in the population. Many of the changes in P. spiculifer may have resulted from their size-dependent preference for deep water sites, and the reduction of these sites during the drought led to adult emigration and increased predation on larger adults. The distribution of population variables between study sites exhibited the same depth-dependent distribution, the shallower reaches having small populations of small adults and large numbers of juveniles. As the habitat depth decreased during the drought, the above subpopulation properties adjusted spatially, apparently following the physical conditions to which they were adapted. These results agree with the stream continuum concept. (Baker-IVI)
W84-02374

HEAVY RAIN IN THE MIDDLE EAST RELATED TO UNUSUAL JET STREAM PROPERTIES,
Hebrew Univ., Jerusalem (Israel). Dept. of Atmospheric Sciences.
U. Dayan, and R. Abramski.
Bulletin of the American Meteorological Society, Vol. 64, No. 10, October, 1983. 4 Fig, 1 Tab, 6 Ref.

Descriptors: *Storms, *Wind, *Middle East, *Flooding, *Rainfall, Saudi Arabia, Jet stream, Climatology, Arid zones, Israel, Sinai Peninsula, Egypt.

A major and fatal flooding event illustrative of rare similar cases in the Middle East was studied. This event, occurring in February of 1975, was compared with three other instances of heavy rains in the same region of the Middle East, two cases in the winter of 1976 that affected parts of Saudi Arabia and south Jordan, and one case in upper Egypt in the winter of 1977 causing heavy rains in the vicinity of Lake Nasser. In all cases the jet stream axis was anticyclonic and in a reversed position. At no other times during this observed period was the jet stream reported to be reversed.

This irregular reversed structure and anticyclonic curvature was associated with a deep and very moist warm air mass above the region. (Baker-IVI)
W84-02390

RAINFALL INTERCEPTION BY AN EVERGREEN BEECH FOREST, NELSON, NEW ZEALAND,
Forest Research Inst., Christ Church (New Zealand).
L. K. Rowe.
Journal of Hydrology, Vol. 66, No. 1-4, p 143-158, October, 1983. 5 Fig, 6 Tab, 38 Ref.

Descriptors: *Interception loss, *Rainfall, *Forest hydrology, Nelson, New Zealand, Interception, Donald Creek, Creeks, Canopy, Throughfall, Seasonal variation.

Data collected over a five year period from April 1977 to March 1982 on a site with a mixed beech canopy was analyzed. The final year of data was used to test the rainfall-interception loss relationships derived from the earlier data. Throughfall under the forest canopy at Donald Creek, Nelson, averaged 69% of the rain falling on the canopy, for 1060 mm of 1530 mm a year. Interception loss averaged 29% of the annual rainfall, or 440 mm/year, using an estimate for stemflow at 2% of the gross rainfall. Seasonal differences in interception loss were significant, ranging from 22% in winter to 35% in summer, and resulted from seasonal variation in evaporation rates from a wet canopy. Seasonal variation in rainfall rate was slight. Comparisons of predicted and observed interception were made to test four models: storm linear regression, monthly linear regression, sine curve and Gash's analytical model. All gave very satisfactory estimates of less than 10% error, and tended to slightly underestimate the measured interception loss. (Baker-IVI)
W84-02463

MAXIMAL RAINFALL ON A SURFACE - THE EPICENTRE COEFFICIENT OF 1- TO 48-HOUR RAINFALL,
CEMAGREF, Antony Cedex (France). Dept. Ressources en Eau.
G. Galea, C. Michel, and G. Oberlin.
Journal of Hydrology, Vol. 66, No. 1-4, p 159-167, October, 1983. 5 Fig, 8 Ref.

Descriptors: *Rainfall, *Estimating, Rainfall area, Rainfall distribution, Spatial distribution, Paris, France.

A sampling tool allowing the hydrologist to determine maximal point rainfall in a given space has been presented using the epicenter coefficient. Its validity should be tested before it can be applied to climates different from that of the Paris (France) area. Once the maximal point rainfall on a surface of area S has been defined, the estimation of its quantiles is carried out in relation to a local rainfall quantile of the same frequency. This ratio, called the 'epicenter coefficient', is then put into an analytical form as a function of the following four variables: area of the studied region, rainfall duration, return period and number of points (or subregions) among which the maximum rainfall was chosen. (Baker-IVI)
W84-02464

USE OF CORRELATION LINKAGES IN THE ASSESSMENT OF DAILY RAINFALL PATTERNS,
Saint David's Univ. College, Lampeter (England). Dept. of Geography.
G. N. Sumner.
Journal of Hydrology, Vol. 66, No. 1-4, p 169-182, October, 1983. 3 Fig, 11 Ref.

Descriptors: *Rainfall distribution, *Forecasting, Mapping, Model studies, Topography, Hydrologic systems, Continental Divide, Australia, New South Wales.

A cartographic technique to indicate discrete rain areas and provide a visual estimate of the degree of correlation distance - decay functions over a wide area is illustrated using a large body of daily rainfall data for a part of Australia. The technique provides a ready and speedy means by which general rainfall patterns may be indicated for a wide area. It does not permit statistical significance levels to be assigned to the relationships obtained. It does provide a convenient, visual and information indication of general rainfall associations; permits a ready visual comparison of month to month charges permitting an overview of seasonal trends; permits the delimitation of approximate rainfall areas based on the presence or absence, frequency and magnitude, of correlation linkages; and it provides a crude assessment of the nature of general correlation fields, indicating anisotropic trends. For New South Wales the technique indicated that the time between April and October the Divide emerges as an important barrier to rainfall occurrence; correlation distance-decay rates are small measured parallel to the Divide and on its coastal flank in particular. In the warmer part of the year rainfall patterns are less constrained by the Divide. Smaller topographically controlled rainfall areas emerge also in the winter months but at all times of the year, if large-scale atmospheric rainfall producing features are frequent and well organized, the impact of local topographic units is masked. (Baker-IVI)
W84-02465

REGIONAL DROUGHTS: A STOCHASTIC CHARACTERIZATION,
Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
M. A. Santos.
Journal of Hydrology, Vol. 66, No. 1-4, p 183-211, October, 1983. 1 Fig, 5 Tab, 6 Ref.

Descriptors: *Droughts, *Stochastic process, Probability distribution, Mathematical studies, Water shortages.

A stochastic characterization of regional droughts is offered through a number of random variables (r.v.), called drought characteristics (d.c.). A precise definition of regional droughts was also sought. Regional drought characterization, using probability theory, is made through the study of a number of random variables associated with regional droughts, such as their duration, intensity and the area undergoing drought effects. The distribution, mean value and variance of these random variables, as well as of some other auxilliary variables, are derived theoretically for most of them. Major conclusions were that all the parameters of both the auxilliary variables (a.v.) and d.c. can be obtained from the determinant properties and the critical level and critical area only. Instantaneous deficit-areas have an approximate normal distribution and instantaneous drought-areas have an approximate normal distribution truncated on the left at the critical area. Regional drought durations have a geometric distribution. Total deficits have an approximate exponential distribution. The drought area and the intensity are not correlated with the drought duration. The longer the drought duration the larger the correlation between this d.c. and the total deficit. The longer the drought duration the smaller the correlation between the total deficit and the intensity. (Baker-IVI)
W84-02466

2C. Snow, Ice, and Frost

ROLE OF GLACIERS IN WATER EXCHANGE IN THE USSR,
A. N. Krenke.
Water Resources, Vol. 9, No. 3, p 254-262, May-June 1982. 2 Fig, 2 Tab, 26 Ref. Translated from Vodnye Resursy, No. 3, p 47-56, May-June, 1982.

Descriptors: *Water resources development, *Glaciers, *Water exchange, *USSR, Precipitation, Runoff, Water quality.

The total accumulation of moisture in glacial systems of the USSR during a long term period averages 47.6 cu km/yr and on average for the glaciers the depth of accumulation is 606 mm. To this figure it is necessary to add more than 5 cu km/yr of liquid precipitation falling on glaciers, so that in all about 53 cu km of water per year passes through them. The average time of the water cycle in the glacial systems of the USSR, determined as the ratio of the mass of the glaciers composing them to the annual volume of accumulation, is equal to about 360 years. While the role of glaciers in water exchange is seen as limited, this pertains only to its quantitative characteristics during one year. At any given time much more water participating in the hydrologic cycle is present in glaciers than in river systems or the atmosphere. The qualitative characteristics of glaciers - their low mineralization, large supply of cold, interannual and year-to-year distribution of melting convenient for agriculture - can result in the fact that glacial water is needed for water consumers more demanding of good water quality than is necessary for irrigation. It may become expedient to deliver water along isolated pipelines, precluding the possibility of mixing glacial waters with waters of poorer quality. (Baker-IVI)
W84-02314

2D. Evaporation and Transpiration

OPERATIONAL ESTIMATES OF AREAL EVAPOTRANSPIRATION AND THEIR SIGNIFICANCE TO THE SCIENCE AND PRACTICE OF HYDROLOGY,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Journal of Hydrology, Vol. 66, No. 1-4, p 1-76, 1983. 27 Fig, 3 Tab, 86 Ref, 4 Append.

Descriptors: *Evapotranspiration, *Hydrologic models, Estimating, Areal hydrology, River basins, North America, Africa, Ireland, Australia, New Zealand, Climatology.

The conceptual and empirical foundations of the complementary relationship, its use in providing the basis for operational estimates of areal evapotranspiration, the testing of such estimates against comparable water-budget values and the potential use of such estimates to provide the impetus for transforming hydrology from a descriptive to a predictive science are detailed. The most recent version of the complementary relationship areal evapotranspiration (CRAE) models is formulated and documented. The reliability of the independent operational estimates of areal evapotranspiration is tested with comparable long term water budget estimates for 143 river basins in North America, Africa, Ireland, Australia and New Zealand. The practicality and potential impact of such estimates are demonstrated with examples which show how the availability of such estimates can revitalize the science and practice of hydrology by providing a reliable basis for detailed water balance studies; for further research on the development of causal models; for hydrological, agricultural and fire hazard forecasts, for detecting the development of errors in hydrometeorological records, for detecting and monitoring the effects of land use changes; for explaining hydrologic anomalities; and for other better known applications. A tabular summary of literature on complementary relationship is provided along with a schematic conceptual basis for complementary relationship and documentation of complementary relationship models. (Baker-IVI)
W84-02458

OPERATIONAL ESTIMATES OF LAKE EVAPORATION,
National Hydrology Research Inst., Ottawa (Ontario).
F. I. Morton.
Journal of Hydrology, Vol. 66, No. 1-4, p 77-100, October, 1983. 9 Fig, 1 Tab, 22 Ref, 1 Append.

Descriptors: *Evaporation, *Lakes, Model studies, Estimating, Predicting, Temperature effects, Humidity, Climatology, Solar radiation, Humidity.

The use of CRLE model to provide operational estimates of shallow lake evaporation from routine observations of temperature, humidity, and sun-

shine duration in the land environment; the development of a routing procedure to take into account the effects of seasonal subsurface heat storage changes in converting estimates of shallow-lake evaporation to estimates of deep-lake evaporation; a test of the results against comparable water budget estimates for eleven lakes in North America and Africa; the development of a procedure for converting lake evaporation to pond evaporation; and ways by which operational estimates of lake evaporation, in combination with operational estimates of areal evapotranspiration, can be applied to problems of water planning and management are reviewed. Descriptions and data sources for ten lakes with water budget estimates of evaporation that are used in the development and testing of the CRLE model are provided. (Baker-IVI)
W84-02459

DIRECT METHOD FOR FOREST TRANSPIRATION MEASUREMENT,
Stavebni Geologie, Prague (Czechoslovakia).
J. Balek, J. Cermak, J. Kucera, and A. Prax.
Journal of Hydrology, Vol. 66, No. 1-4, p 123-131, October, 1983. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Transpiration, *Forest hydrology, Evapotranspiration, Soil water, Water loss, Remote sensing, Aerial photography, Czechoslovakia.

A direct method of transpirational measurement is described which provides very useful values for the water balance simulation of forested watersheds. The simultaneous measurement of meteorological factors and calculations of the potential evaporation during the period of the transpirational measurement indicate a close relationship between the two processes. However, an additional significant factor was the soil moisture regime in the root zone. The availability of water in the saturated zone increased significantly the amount of water transpired during the dry periods and after, while the transpiration of the plant on the soil profile without a saturated zone was much lower. While the transpiration from a forest drawing from an unlimited storage of soil water can reach values close to the potential evaporation, the transpiration from a forest with a less developed saturation zone, or with none at all, is considerably reduced. Formulas so far developed have only regional validity, but a simultaneous evaluation of results from several stands with different conditions can be used for further generalization. The combination of ground observations of transpiration with infrared aerial photography from a low-flying model aircraft provides a solid basis for the extrapolation of the results. (Baker-IVI)
W84-02461

FOREST TRANSPIRATION: A CONSERVATIVE HYDROLOGICAL PROCESS,
Institute of Hydrology, Wallingford (England).
J. Roberts.
Journal of Hydrology, Vol. 66, No. 1-4, p 133-141, October, 1983. 1 Fig, 2 Tab, 27 Ref.

Descriptors: *Forest hydrology, *Transpiration, Hydrological models, Europe, Forest understories, Climates, Soil water, Moisture availability, Litter, Stomata.

Information currently available on forest transpiration from studies in European forests is reviewed and the importance of some processes which might tend to equalize transpiration between forests is considered. Four processes are considered as maintaining annual transpiration at similar, rather low, levels. Understoreys are regarded as effective buffers to the canopy differences. To a lesser extent this role can also be filled by the litter layer below trees. A further limit to the level of transpiration is imposed by the interrelationships between two climatic factors, radiation and humidity deficit, both of which influence stomatal behavior and also drive transpiration. While the influence of variations in soil moisture on transpiration would seem at first sight to be important, there is increasing evidence that soil-moisture levels rarely limit transpiration in field-grown trees. It seems probably that where forests exhibit a rather limited daily transpiration loss, perhaps because of the atmospheric humidity/surface resistance feedback, the control of transpiration by available soil water is negligible. Forests, established naturally or artificially, have requirements for water which do not appear to exceed the availability of water at the site in dry years. (Baker-IVI)
W84-02462

2E. Streamflow and Runoff

STREAMFLOW OF THE OCCOQUAN RIVER IN VIRGINIA AS RECONSTRUCTED FROM TREE-RING SERIES,
Geological Survey, Reston, VA. Water Resources Div.
R. L. Phipps.
Water Resources Bulletin, Vol. 19, No. 5, p 735-743, October, 1983. 7 Fig, 6 Tab, 10 Ref.

Descriptors: *Tree-rings, *Streamflow, *Occoquan River basin, Virginia, History, Reconstruction, Low flow, Drought.

Tree-ring indices representing seven sites were used to reconstruct monthly summer streamflow in the Occoquan River basin of northern Virginia from 1841 to 1975. Attempts were made to reconstruct flow for each of the months, April through August. Reconstructions for June, July, and August were judged most reliable. Major midsummer flow minima persisting for more than one year were reconstructed as having occurred in the early 1870's, the early 1930's, and the mid-1960's. Aside from these major dry periods, a greater frequency of extreme low flow during individual years is indicated for the entire record than for the most recent 50 years. (Author's abstract)
W84-02161

PARTIAL DURATION SERIES METHOD REVISITED,
Technical Univ. of Lisbon (Portugal). Dept. of Civil Engineering.
L. V. Tavares, and J. E. da Silva.
Journal of Hydrology, Vol. 64, No. 1/4, p 1-14, July, 1983. 1 Fig, 4 Tab, 4 Ref.

Descriptors: *Floods, *Variability, Model studies, Flood control, Estimating, Flood recurrence interval, Flood magnitude.

Partial duration series have been used to estimate the relationship of flood magnitude to return period as has the annual maxima method. The relative efficiency of these two methods is evaluated considering separately independent and autocorrelated exceedances. The estimation variance of the flood magnitude associated with a given return period can be underestimated or overestimated by the approximation if the average annual number of exceedances is higher or smaller than 2. The partial duration series method has a significantly lower estimation variance than the annual maxima method if the average annual number of exceedances is greater than 2, assuming that the exceedances can be modelled by a Poisson process and are an i.i.d. sequence of negative exponential variables. The truncation level, L, should be as low as possible providing that the model assumptions are still valid but when L is decreased the hypothesis which is first violated is usually the one regarding the serial independence of the exceedances. (Baker-IVI)
W84-02197

APPLICABILITY OF THE JOHNSON S SUB B -CURVE TO ANNUAL STREAMFLOW DISTRIBUTIONS,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and W.-B. Chow.
Journal of Hydrology, Vol. 64, No. 1/4, p 15-24, July, 1983. 2 Tab, 13 Ref.

Descriptors: *Streamflow, *Model studies, Estimating, Mathematical studies, Method of moments.

The applicability of the Johnson S sub B -curve to the modelling of annual streamflows is evaluated using actual data. The methods for its parameter estimation are summarized and discussed based on the results obtained. The findings after application of the S sub B -curve to 20 sets of annual streamflows with 7 differing alternatives for parameter estimation tend to support the theory that the curve can be used for representing annual streamflow distributions. Although in this study in 3 out of 20 cases the S sub B -curve could not be used, this was due to failures in the methods for parameter estimation rather than by being rejected in the goodness-of-fit test. The method of moments turns out to be the most applicable for the data concerned. Since there are four parameters involved, the first four moments are needed for their estimation. Their estimated values would be subject to large sampling errors, especially when the length of record is short. (Baker-IVI)
W84-02198

EFFECTIVE RECORD LENGTH FOR THE T-YEAR EVENT,
Geological Survey, Reston, VA.
G. D. Tasker.
Journal of Hydrology, Vol. 64, No. 1/4, p 39-47, July, 1983. 2 Fig, 2 Tab, 11 Ref.

Descriptors: *Flow, *Estimating equations, Estimating, Flow pattern, Flow characteristics, Groundwater, Channels, Model studies, Design criteria.

The effect of serial dependence on the reliability of an estimate of the T-year event is important in hydrology because design decisions are based upon the estimate. The relative reliability, measured by the effective number of observations, for the T = 2, 10, 20, 50, and 100 yr events as a function of the number of actual observations and the lag-one serial correlation coefficient, is given. These values can be used to help assess the effects of serial dependence on the level of uncertainty in planning decisions based on the T-year event. In addition, replacing actual record length by effective record length may extent the range of applicability of certain network design techniques. A lag-one autoregressive model is assumed with either a normal or Pearson Type-III distribution term. If observations are serially correlated, the effective record length should be used to estimate the discharge associated with the expected exceedance probability. (Baker-IVI)
W84-02200

EFFECT OF MOLE DRAINAGE ON THE HYDROLOGICAL RESPONSE OF A SWELLING CLAY SOIL,
Institute of Hydrology, Wallingford (England).
M. Robinson, and K. J. Beven.
Journal of Hydrology, Vol. 64, No. 1/4, p 205-223, July, 1983. 9 Fig, 1 Tab, 34 Ref.

Descriptors: *Mole drainage, *Clays, Soil properties, Drainage, Soil moisture, Saturated soils, Runoff, Swelling clay soil, Flow, Model studies.

A plot experiment to determine the effects of mole drainage on the hydrological response of a swelling clay soil under pasture is described. The response is very dependent on antecedent moisture conditions, and that higher peak flows may be generated under relatively dry conditions on the (drier) drained plot. This appears to be related to the generation of flows in interpedal macropores supplying water to the mole drains. Under wet conditions, the hydraulic efficiency of the macropores is reduced by swelling of the clay and surface saturation develops on the undrained plot. This results in generally higher peak discharges than from the drained plot. Recession discharges and total water yields are almost always higher from the drained plot. It may be very difficult to detect or model the influence of clay land drainage on river flows. (Baker-IVI)
W84-02209

FLOW NET FOR TWO-DIMENSIONAL LINEARIZED INFILTRATION AND EVAPORA-

TION FROM NONUNIFORM AND NONPERIODIC STRIP SOURCES,
Karadeniz Teknik Univ., Trabzon (Turkey). Dept. of Civil Engineering.
V. Batu.
Journal of Hydrology, Vol. 64, No. 1/4, p 225-238, July, 1983. 6 Fig, 11 Ref.

Descriptors: *Unsaturated flow, *Flow nets, *Soil water, Infiltration, Evaporation, Mathematical equations, Fourier analysis, Permeability coefficient.

General analytical expressions are derived for flow nets caused by infiltration or evaporation with random input values from nonuniform and nonperiodic strip sources on the soil surface using the theory of steady unsaturated flow in homogeneous and isotropic porous media. The analysis is based on an exponential relationship between the unsaturated hydraulic conductivity and soil-water pressure, leading to a simple expression for the matrix flux potential and to a linearization of the problem. Fourier analysis is used in the mathematical procedures. The solutions for a uniform infiltration rate from two strip sources and a uniform evaporation rate from an intermediate strip are presented as special cases. The expressions for these special cases have been evaluated using Filon's numerical integration method. Numerical results for these special cases are presented and discussed. (Author's abstract)
W84-02210

WATER MOTION IN A DECIDUOUS FOREST DURING SNOWMELT,
Scarborough Coll., Westhill (Ontario).
A. G. Price, and L. K. Hendrie.
Journal of Hydrology, Vol. 64, No. 1/4, p 339-356, July, 1983. 9 Fig, 2 Tab, 27 Ref.

Descriptors: *Snowmelt, *Runoff, Catchment areas, Unsaturated flow, Vegetation, Snow cover, Snowpack, Deciduous forests, Soil water.

The ways in which snow meltwater moves through a drainage basin were investigated. The function of the unsaturated zone in modulating and transmitting the meltwater pulse was defined. The basin selected for snowmelt runoff research was chosen because of its uniform soil vegetation and snowcover characteristics, and yet, even in this system, variability was high and was reflected in a complexity of process. Indirect measures of soil water motion suggest that subsurface stormflow may occur even in an apparently homogeneous, permeable sand. Even though the pattern of surface water inputs was simple, once this spatially uniform and temporally predictable snowmelt input was imposed on a surface of spatially and temporally predictable variable characteristics, great complexity results. Processes within the unsaturated zone were of primary importance, and their complexity is not eased by conditions occurring during snowmelt. (Baker-IVI)
W84-02214

IDENTIFICATION OF RUNOFF SOURCES OF A FORESTED LOWLAND CATCHMENT; A CHEMICAL AND STATISTICAL APPROACH,
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
For primary bibliographic entry see Field 2K.
W84-02215

PREDICTION OF THE HYDRAULIC REGIME OF RIVERS AND RESERVOIRS,
V. M. Lyatkher.
Water Resources, Vol. 9, No. 6, p 650-675, November-December, 1982. 14 Fig, 88 Ref. Translated from Vodnye Resursy, No. 6, p 118-144, November-December, 1982.

Descriptors: *Flow measurement, *Rivers, *Reservoirs, Mathematical studies, Hydraulics, Fluid mechanics, Flow velocities, Water level, Hydrodynamics, USSR.

The most significant trends in the area of hydrodynamics of rivers and reservoirs are noted for the past 5-10 years in the Soviet Union. In general there has been an intense development in the methods of describing flows in rivers and reservoirs. In the near future it is expected that there will appear program packs permitting the prediction of hydraulic regimes with sufficient accuracy with a small number of empirical constants. At the same time the need is being felt of an expansion of experimental, both laboratory annd prototype, investigations to refine the formulation of the problem with respect both to the selection of mathematical models, boundary conditions being included, and with respect to an objective description of the initial data on the objects being studied. A need for coordinating the efforts of various investigators working in separate but allied directions within the framework of the general problem of hydrophysics of water bodies is noted. (Baker-IVI)
W84-02339

CALCULATION OF CHANNEL FLOWS IN THE PRESENCE OF A REGULATING HYDROELECTRIC SCHEME,
G. P. Epikhov.
Water Resources, Vol. 10, No. 1, p 70-76, January-February, 1983. Translated from Vodnye Resursy, No. 1, p 113-119, January-February, 1983.

Descriptors: *Channel flow, *Hydroelectric plants, *Computers, Mathematical models, Algorithms, Planning, Decision making, Canals, Hydraulic structures.

Many practical problems require the creation of effective methods of calculating channel flows on a computer on the basis of a system of channels and canals in which there are various hydraulic structures for streamflow regulation. An algorithm is presented for accurate computer calculation of channel flows in the presence of a regulating hydroelectric scheme. A system of two consecutive streams between which is located a hydroelectric scheme is examined. To check the performance of the algorithm a hypothetical object with morphologic characteristics similar to the real ones was selected. The hydroelectric scheme is intended to protect river stretches upstream of it from saline seawaters. The results of the numerical experiments showed the good performance of the algorithm and permits recommending it for calculations on real objects. (Baker-IVI)
W84-02347

RELATION OF FIELD STUDIES AND MODELING IN THE PREDICTION OF STORM RUNOFF,
Washington Univ., Seattle. Dept. of Geological Sciences.
T. Dunne.
Journal of Hydrology, Vol. 65, No. 1-3, p 25-48, August, 1983. 6 Fig, 2 Tab, 96 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, *Snowmelt, Runoff, Storms, Melt water, Storm seepage, Subsurface water, Prediction, Mathematical models, Hydrographs.

Routine methods of predicting strom hydrographs do not require accurate conceptual models of storm runoff processes. Application of hydrology to the analysis of landform evolution and other scientific and land-management problems requires realistic concepts of runoff processes and their variation within drainage basins. These concepts need to be refined, developed, and formalized through more vigorous combination of rigorously designed field experiments and realistically physically based mathematical models. If field studies were routinely designed around a rigorous theory, it is more likely that critical variables waould be measured, which are now usually avoided because of the difficulty of measurement or because the field worker has neither insight into nor interest in their use for modeling to generalize his results. For personnel on the modeling side, there is a need to present models, computational details, and their data requirements more clearly, and to become involved in fieldwork, at least in the planning and data analysis phases. Runoff mechanisms occurring during rainfall are covered along with the special case of runoff generated by these same mechanisms under snowmelt conditions that cause significant differences from runoff generated by rainfall. (Baker-IVI)
W84-02439

SOME PROBLEMS IN TRANSFERRING HYDROLOGICAL RELATIONSHIPS BETWEEN SMALL AND LARGE DRAINAGE BASINS AND BETWEEN REGIONS,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
D. H. Pilgrim.
Journal of Hydrology, Vol. 65, No. 1-3, p 49-72, August, 1983. 11 Fig, 2 Tab, 23 Ref.

Descriptors: *Drainage basins, *Rainfall-runoff relationships, Hydrologic models, Model studies, Drainage, Storms, Storm runoff.

There are problems involved in transferring hydrological relationships between small and large drainage basins and between regions. Basin processes vary considerably from one region to another, and over small distances within one region. These processes include the type and characteristics of storm runoff, small-scale variations of infiltration and runoff, spatial aspects of nonlinear flood response, annual runoff relations and channel transmission losses. Attempts to generalize are thus dangerous, and counter-productive to the wider understanding of processes and the development of valid relationships. Examples are offered of problems in identifying similarity relationships resulting from the interaction of model parameters with basin size, and from random and systematic errors in available hydrological data. There is a need for better knowledge of actual hydrological processes at basin scale. There is a great need to gather data from field observations over a wide range of regions in addition to streamflow and rainfall data currently being collected. Much more information is required on the spatial variations of many hydrological processes. (Baker-IVI)
W84-02440

HYBRID MODEL FOR FLOW FORECASTING ON LARGE CATCHMENTS,
University College, Galaway (Ireland). Dept. of Engineering Hydrology.
J. E. Nash, and B. I. Barsi.
Journal of Hydrology, Vol. 65, No. 1-3, p 125-137, August, 1983. 5 Fig, 5 Tab, 5 Ref.

Descriptors: *Hydrologic models, *Flow measurement, Forecasting, Catchment areas, Seasonal variations, Rainfall-runoff relationships.

On catchments whose flow variations is highly seasonal a simple seasonal forecast for any date, as the mean of the observed flows on that date in previous years, may be better, in the least-squares sense, than a forecast obtained from even a good rainfall-discharge model. The concept of rainfall-discharge has been combined with that of purely seasonal prediction to obtain a better forecast that would be possible to obtain from either method used singly. Data from the W.M.O. Intercomparison is used to test the hypothesis that the rainfall and discharge functions of time expressed as departures from the seasonal means are linearly related. Significantly better results were obtained using this hybrid model than were obtained with the seasonal predictor alone or with an elaborate rainfall-discharge model. Models of this kind may be useful on large catchments exhibiting marked seasonal behavior. (Baker-IVI)
W84-02443

CATCHMENT GEOMORPHOLOGY AND THE DYNAMICS OF RUNOFF CONTRIBUTING AREAS,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
K. Beven, and E. F. Wood.
Journal of Hydrology, Vol. 65, No. 1-3, p 139-158, August, 1983. 10 Fig, 3 Tab, 22 Ref.

Descriptors: *Catchment areas, *Geomorphology, *Runoff, Model studies, Flood frequency, Prediction, Storms, Storm runoff, Flood frequency.

The dynamic nature of areas contributing to runoff is described along with their relationship to the geomorphological structure of catchments. Example calculations are offered which demonstrate that both runoff and flood frequency predictions may be very sensitive to assumptions about the nature of the contributing area. A simple methodology is proposed to predict variable contributing areas on the basis of initial storage deficits, with an extension to allow the prediction of combined surface and subsurface responses. The procedure was applied to four catchments ranging in size from 5 to 456 sq km. This improves on the earlier response model by allowing extension of the contributing area by filling of initial deficits, and also a more explicit treatment of time delays in the unsaturated zone. The results presented demonstrate interaction of the three calibrated parameters in the simplified model but are sufficiently accurate to suggest that the method may be worth further study. (Baker-IVI)
W84-02444

GEOMORPHOCLIMATIC ESTIMATION OF EXTREME FLOW PROBABILITIES,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. R. Cordova, and I. Rodriguez-Iturbe.
Journal of Hydrology, Vol. 65, No. 1-3, p 159-173, August, 1983. 7 Fig, 7 Tab, 7 Ref. Venezuelan National Council for Scientific and Technology grant S1-1212.

Descriptors: *Runoff, *Geomorphology, *Catchment areas, Basins, Flood frequencies, Probabilities, Prediction, Runoff, Storm runoff, Venezuela.

A simple method is developed for estimating flood probabilities, using geomorphoclimatic information. The procedure uses rainfall data and those geomorphologic parameters which were included in the geomorphoclimatic instantaneous unit hydrography. The methodology avoids the coupling of the frequencies in intensity and duration of rainfall with a peak discharge of a certain return period. Such an approach will be extremely useful in regions with great scarcity of streamflow data and moreover may provide further light in the understanding of hydrologic processes at a basin scale. A basin in Venezuela is analyzed in detail and the results are compared with the flood probabilities obtained from the historical streamflow series. The main assumption in this method is that the maximum depth of effective rainfall results in maximum discharge. This is certainly true in the tropics, but there are parts of the world where the maximum rainfall depths are due to convective summer thunderstorms and yield relatively small peak flows, whereas sequences of smaller storms during the spring maintain the soil near saturation and usually yield the peak annual flows. In this case the analysis of maximum depth of rainfall has to be done using the storm events of the rainy season, excluding summer events. (Baker-IVI)
W84-02445

LINEAR CHANNEL AND ITS EFFECT ON THE GEOMORPHOLOGIC IUH,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
D. A. Kirshen, and R. L. Bras.
Journal of Hydrology, Vol. 65, No. 1-3, p 175-208, August, 1983. 10 Fig, 7 Tab, 10 Ref.

Descriptors: *Hydrographs, *Channels, Geomorphology, Linear channels, Boundary conditions, Physiography, Hydrographic models.

The instantaneous unit hydrograph (IUH) is derived as a function of the basin's geomorphological and physiographic characteristics. The response of the individual channels composing the basin are inherent in the basin IUH. Solving the continuity and momentum equations for the boundary conditions defined by the IUH allows one to derive the response of the individual channels. In the derivation of the basins' IUH both the effects of upstream and lateral inflow to the channels are considered. A basis for comparison between the results produced by this model and those produced by a model where the channel's response is assumed to be an exponential distribution is provided by the time to peak and peak response. Such comparisons indicate that if the approach taken herein is accurate then the type of channel response used for the basin's IUH is significant and future efforts must be directed towards parameter estimation. (Baker-IVI)
W84-02446

STABLE-CHANNEL DESIGN IN ALLUVIAL RIVERS,
Ministry of Works and Development, Christchurch (New Zealand). Water and Soil Div.
G. A. Griffiths.
Journal of Hydrology, Vol. 65, No. 4, p 259-270, September, 1983. 1 Fig, 1 Tab, 29 Ref.

Descriptors: *Alluvial rivers, *Channel flow, River beds, Basins, Stability analysis, Channel stability, Sediment discharge, Channel design.

A general problem of stable-channel design is prediction of how a river reach adjusts to transmit imposed water and sediment discharges. A theory of stable-channel design is deduced from the condition that, for any given steady flow, total sediment concentration maintains a balanced average in space and time within a stable channel. This condition for stability applies during changes in channel position but does not constrain them. A stability index is defined in terms of concentration of bed-material load. A channel can be defined as stable if its gross dimensions oscillate about constant values in space and time irrespective of changes in channel position. A quantitative condition for channel stability is that for any specified steady flow and time interval, the temporal mean value of average spatial variation in total sediment concentration within a given channel is constant, independent of alterations in channel alignment. Two distinct stable-channel design methods, threshold and mobile-bed, may be deduced corresponding to zero and constant finite sediment transport rate. Design formulae, given for each method, are applicable to cross-sections or reaches, independent of planform, of both sand-silt and gravel-bed rivers. An expression for pointwise evaluation along a channel of the ratio of bedload to suspended sediment discharge, for a specified steady flow can be inferred. (Baker-IVI)
W84-02449

INFILTRATION AND RUNOFF PREDICTIONS FOR A GRASSLAND WATERSHED,
Oak Ridge National Lab, TN. Environmental Sciences Div.
R. J. Luxmoore.
Journal of Hydrology, Vol. 65, No, 4, p 271-278, September, 1983. 3 Fig, 12 Ref.

Descriptors: *Infiltration, *Runoff, *Grasslands, *Watersheds, Storm runoff, Prediction, Mathematical studies, Hydrologic models, Hortonian equations, Simulation, Chickasha, Oklahoma.

The relative roles of three sources of runoff (direct surface runoff of noninfiltrating water, runoff generated from through fall onto saturated zones in the watershed, and subsurface runoff) in streamflow generation at the R5 watershed at Chickasha, Oklahoma, were simulated using field-determined infiltration characteristics and heterogeneity of soil hydraulic properties derived by a scaling procedure. Several aspects of the simulation predictions are presented to evaluate the suitability of the infiltration data inputs for predicting the hydrologic processes of the R5 watershed. Any discrepancy in Hortonian runoff from the infiltration calculations was compensated for by variable contributing area (VCA) runoff in the hydrologic simulation. Evaluation of the VCA parameterization suggested that contributions of VCA runoff to total streamflow were unreasonably high and that the infiltration parameters overpredicted annual infiltration. Field measurements of infiltration characteristics for hydrologic studies should be obtained during the season with predominant Hortonian runoff. (Baker-IVI)
W84-02450

TIME SERIES ANALYSES OF ANNUAL FLOWS OF AUSTRALIAN STREAMS,
Melbourne Univ., Parkville (Australia). Dept. of Civil Engineering.
R. Srikanthan, T. A. McMahon, and J. L. Irish.
Journal of Hydrology, Vol. 66, No. 1-4, p 213-226, October, 1983. 7 Fig, 6 Tab, 11 Ref.

Descriptors: *Time series analysis, *Streamflow, Model studies, Mathematical studies, Australia, Autocorrelation.

Six tests of dependence - autocorrelation, median crossing, turning points, length-of-runs, rank difference and cummulative periodogram - were applied to annual streamflow data for 156 Australian streams. Based on these analyses, about 28% of the streamflow series were found to be non-random. Autocorrelation and partial autocorrelation functions were used to determine the appropriate form of a linear model for each stream. Procedures for identifying suitable models for those sites which appear to have a clearly non-random sequence of annual streamflow are outlined, and a priori choice of appropriate model type is indicated for each of the sites whose streamflow data exhibit significant short-memory persistence. For most sites in Australia, and for most applications meriting simulations of annual streamflow records, a first-order autoregressive scheme is either required to fit the data, or represents a significant improvement over a white noise model. For about one site in six, a higher order autoregressive model, a moving average model, or a mixed autoregressive moving average model is indicated. (Baker-IVI)
W84-02467

ANNUAL VARIATIONS OF GROUND AND STREAMFLOW TEMPERATURES IN SMALL FORESTED VALLEYS,
Oita Univ. (Japan). Dept. of Earth Science.
H. Kawanishi.
Journal of Hydrology, Vol. 66, No. 1-4, p 253-267, October, 1983. 6 Fig, 5 Tab, 3 Ref.

Descriptors: *Forest hydrology, *Water temperature, Ground temperature, Streamflow, Model studies, Heat transfer, Valleys, Groundwater movement, Topography, Mathematical models.

A two-dimensional numerical model was developed to evaluate the effects of topography and groundwater flow on the annual variations of ground temperature in a forested valley. Heat exchange on the forest floor was discussed on the basis of the observed data. Surface water temperature was computed from the ground temperature field in a valley bottom, taking into account the effect of heat transport by the running water. The rate of heat exchange on the forested floor was shown to be proportional to the difference between air and ground surface temperatures. Ground temperature in a valley bottom is greatly affected by the topography and the streamflow, and to only a small degree by the groundwater flow. Surface water temperature was computed from the ground temperature field in a valley by assuming a smaller rate of heat exchange in the bottom than on the slopes. (Baker-IVI)
W84-02470

OBSERVATIONS ON THE TIME OF TRAVEL OF WAVES IN THE RIVER SKERNE, ENGLAND, AND THE EFFECT OF AQUATIC VEGETATION,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
L. Hamill.
Journal of Hydrology, Vol. 66, No. 1-4, p 291-304, October, 1983.

Descriptors: *Solitary waves, *River Skerne, *England, *Vegetation, Aquatic plants, Aquatic weeds, Seasonal variation, Mine drainage, Path of pollutants, Time of travel.

The water pumped from mine workings during periods of cheap off-peak electricity formed a series of relatively uniform solitary waves in the River Skerne. The passage of the waves was recorded at three river gauging stations during 1973 and 1974. The analysis indicates that in some circumstances the time of travel of waves may be increased significantly during the summer months, and may follow an annual cycle as a result of weed growth in the river channel. Although it is difficult to define quantitatively the increase in travel time that will occur in a particular situation, it can be considerable. The correction factor will vary seasonally also and will not have a constant value as assumed by others. To study effectively the time of travel of a pollutant, a series of radiotracer surveys would be needed at different times of the year. Instead of a radiotracer survey the observed velocity of flood waves can be used to assess the time of travel. However, unless the flood waves are frequent and consistent, considerable errors could be incurred. The effect of seasonal weed growth in the river channel must be considered. The claim that from one time of travel survey at low flows and one set of hydrolgical records at a number of gauging stations along the river the times of travel of pollutants can be calculated under a range of flow conditions is unjustified. (Baker-IVI)
W84-02472

BUILDUP OF DISCHARGE ALONG THE COURSE OF A MOUNTAIN STREAM DEDUCED FROM WATER-QUALITY ROUTINGS (EC ROUTINGS),
Vrije Univ., Amsterdam (Netherlands). Inst. voor Aardwetenschappen.
C. A. J. Appelo, R. Becht, A. A. Van de Griend, and T. C. M. Spierings.
Journal of Hydrology, Vol. 66, No. 1-4, p 305-318, October, 1983. 7 Fig, 1 Tab, 28 Ref.

Descriptors: *Water quality, *Mountain streams, *Stream discharge, Italy, Alps, Conductivity, Runoff, Catchments, Hydrology.

Changes in electrical conductivity (EC) were examined along the course of a high mountain stream in the northern Italian Alps. The EC of water contributing to the stream varies with the lithology drained, thus permitting a chemical gauging of contributing area. Recognition of small changes in discharge is possible using EC routing of the stream. A rapid semi-quantitative insight is thus provided into the buildup of runoff production from various parts of the catchment under different hydrological conditions. The method is seen as a valuable tool for the recognition of different contributing areas. When conditions are favorable it can show the response of sub-areas to changing hydrological conditions. The method may thus contribute to a practical realization of the partial contributing area concept in hydrology. (Baker-IVI)
W84-02473

APPLICATION OF FLOW MODELS IN AN ALPINE CATCHMENT AREA USING TRITIUM AND DEUTERIUM DATA,
Institut fuer Radiohydrometrie der Gesellschaft fuer Strahlen-und Umweltforschung, Munich (Germany, F.R.).
P. Maloszewski, W. Rauert, W. Stichler, and A. Herrmann.
Journal of Hydrology, Vol. 66, No. 1-4, p 319-330, October, 1983. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Hydrologic models, *Runoff, *Flow, *Alpine regions, *Tritium, *Deuterium, Precipitation, Lainbach Valley, Bavarian Alps, West Germany, Basins, Catchment basins, Groundwater storage.

Measurements of tritium and deuterium concentrations in precipitation and runoff were in addition to conventional investigation methods used to provide some further insight into the storage properties of Lainbach valley, a catchment area of 18.7 sq km and 670 to 1801 m above sea level in the Bavarian Alps. Different simple hydrological models were used to model the basin. The application of specific flow models to the isotopic output data was employed to derive information about mean transit times of subsurface water and storage volumes of basin reservoirs. Based on fitted mean transit times of 0.8 years for the upper subsurface reservoir and 7.5 years for the lower subsurface reservoir, storage volume equivalents were obtained of 0.6 and 1.9 m of water depth, respectively. The estimates obtained of mean residence times of groundwater and its storage volumes, based on measurements of environmental isotopes and their interpretation by flow model computations, seem to be realistic. The results are supported by the agreement obtained from using two isotopes with different origin and input functions, even though the degree of accuracy of the results can hardly be evaluated. It is desirable to have more detailed hydrogeological information for an independent evaluation of the subsurface storage capacity. The example showed that a refined treatment of the hydrological problem by modeling can be founded on both tritium and deuterium measurements. (Baker-IVI)
W84-02474

2F. Groundwater

NUMERICAL MODELING OF SALTWATER INTRUSION IN THE NORTHERN GUAM LENS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
D. N. Contractor.
Water Resources Bulletin, Vol. 19, No. 5, p 745-751, October, 1983. 9 Fig, 10 Ref.

Descriptors: *Saline water intrusion, *Mathematical models, *Northern Guam lens, *Groundwater level, Pumping, Groundwater management, Geohydrology, Groundwater recharge, Phreatic surface.

The two-dimensional finite element saltwater intrusion model (SWIGS2D) has been applied to the Northern Guam lens. The Northern Guam lens was discretized into 299 linear, triangular elements and 189 nodes. The model was calibrated using 1978 hydrologic data. The output of the model was compared with measured water levels in six observation wells. The calibrated values of permeability and porosity were then used to verify the model using 1979 data. A calibrated and verified model can be used to make an infinite variety of management and planning studies. Three applications are provided that would be considered typical management runs. Steady state runs were made to compare the four conditions of no pumping, 1978 pumping levels, twice 1978 pumping levels, and five times 1978 pumping levels. There were only minor changes in water levels and aquifer volumes for the first three pumping rates, but significant changes did occur for five times the 1978 pumping rate. The effect of zero recharge to the aquifer was demonstrated for the pumping levels existing during 1978. During the dry months of the year, the water levels in wells are controlled by the sea level changes; in the rainy months the water levels respond to the recharge. The final run shows how long the aquifer takes to reach steady state when the pumping rate is increased from the 1978 pumping level to twice that value. The pumping rate was doubled and the unsteady changes in the phreatic surface and the interface elevation were studied. The phreatic surface declines substantially in a short period of time and then declines at a much lower rate to its final steady value. The interface moves much more gradually over a much longer period of time. The program can be used for numerous other studies for management and planning purposes. (Moore-IVI)
W84-02162

NUMERICAL MODEL DESCRIBING UNSTEADY FLOW IN A FRESH WATER LENS,
Guam Univ., Agana. Water and Energy Research Inst. of the Western Pacific.
J. F. Ayers, and H. L. Vacher.
Water Resources Bulletin, Vol. 19, No. 5, p 785-792, October, 1983. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Unsteady flow, *Freshwater lens, *Islands, *Groundwater recharge, Mathematical models, Geohydrology, Somerset Island, Bermuda.

A two-dimensional numerical model is developed to simulate the water table configuration under unsteady flow conditions (variable recharge) for a small coastal or oceanic island of any shape. The model is based on the Ghyben-Herzberg principle and the Dupuit assumptions. Finite difference equations are formulated from the governing flow equation and solved by the iterative alternative-direction-implicit procedure. The resultant tri-diagonal matrices are resolved utilizing the well known Thomas algorithm. Somerset Island, one of the six main land masses of Bermuda, is the prototype. The island is approximately 6 sq km in area and is underlain by a freshwater lens. Recharge to the island is derived from rainfall. Application of the model to the undeveloped fresh water lens of Somerset Island produced results in very good agreement with field observations and previously estimated hydrogeologic parameters. The model appears to be a viable means of predicting the response of a Ghyben-Herzberg lens to current, expected, or proposed hydrologic stresses such as variable recharge. Some caution is needed when interpreting model results for field cases where the water table fluctuations are rapid or where the thickness of the transition zone is great. (Moore-IVI)
W84-02168

EFFICIENT PROCEDURE IN THE DIGITAL SIMULATION OF AQUIFER SYSTEMS,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and R. V. S. S. Avadhanulu.
Journal of Hydrology, Vol. 64, No. 1/4, p 159-174, July, 1983. 4 Fig, 5 Ref, 1 Append.

Descriptors: *Aquifers, *Simulation analysis, Digital computers, Computers.

The simulation of complex aquifer systems by interative solutions of the relevant equations involves the estimation and storage of several intermediate arrays of numbers. These occupy extensive memory and large storages. This has necessitated the development of an optimization which is efficient in terms of memory required. The program code developed for the technique is tested using a strongly implicit procedure on a two dimensional aquifer system. The results showed a saving of about 98% in the core memory utilization. (Author's abstract)
W84-02206

ANALYSIS OF DUG-WELL TEST DATA,
Center for Water Resources Development and Management, Calicut (India). Ground Water Div.
S. P. Rajagopalan.
Journal of Hydrology, Vol. 64, No. 1/4, p 175-188, July, 1983. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Hydraulic gradient, *Wells, *Mathematical models, Discharge hydrographs, Model studies, Drawdown, Water supply development, India.

Test data from dug wells is analyzed. A mathematical model is presented with the boundary condition along the well face being defined on the basis of alternative assumptions made on how the radial hydraulic gradient is distributed over the well face. Approximate equations for the recovery phase are obtained based on an additional assumption that the radial hydraulic gradient along the well face is linearly related to the drawdown in the dug well. The use of these equations leads to the determination of a parameter of the form PrB (where Pr is the lateral permeability of the aquifer and B is a constant) and of the time required for the dug well to recoup fully. A simple field test procedure is adopted to obtain conditions of different discharges from the well and an empirical relationship between the parameter PrB and the well discharge is established for the test well site. The approximate equations that are developed also find use in

correcting some of the common anomalies in the abstraction phase data. (Baker-IVI)
W84-02207

CONCEPTUALIZATION OF A MODEL FOR THE MOVEMENT OF POLLUTION IN AN AQUIFER - APPLICATION TO THE RHINE GRABEN (CONCEPTION D'UN MODELE DE PROPAGATION DE POLLUTION EN NAPPE AQUIFERE - EXEMPLE D'APPLICATION A LA NAPPE DU RHIN),
Bureau de Recherches Geologiques et Minieres, Strasbourg (France). Service Geologique Regional Alsace.
For primary bibliographic entry see Field 5B.
W84-02212

MODELLING OF HYDROLOGIC PROCESSES IN A SMALL NATURAL HILLSLOPE BASIN, BASED ON THE SYNTHESIS OF PARTIAL HYDROLOGICAL RELATIONSHIPS,
Tokyo Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W84-02213

CORRELATION MODEL FOR CALCULATING GROUNDWATER LEVEL RESPONSES IN THE SISHEN NORTH MINE,
Department of Environmental Affairs, Pretoria (South Africa). Div. of Geohydrology.
J. Willemink.
Water South Africa, Vol. 9, No. 3, p 103-109, July, 1983. 7 Fig, 6 Ref.

Descriptors: *Aquifers, *Mine drainage, Drawdown, Groundwater level, Hydrographs, Pumping, Model studies, Depression head, Observation wells, Sishen, South Africa.

Due to a lack of observation wells and geohydrological knowledge at greater distances from the center of pumping in a mine where groundwater is abstracted on a large scale for dewatering purposes, it is not always possible to delineate the aquifer and to establish the spreading of the depression cone of dewatering. Consequently, it will be impossible to make a fairly good assessment of the groundwater supply. A method has been developed to calculate the future drawdown of the groundwater level inside the mine, which reflects the depletion of the groundwater supply, by correlating the variable daily pumping figures and the measured groundwater level responses. The application of this computation method is illustrated by the dewatering of the Sishen North Mine (South Africa). (Author's abstract)
W84-02310

LONG-TERM VARIATIONS OF GROUNDWATER RESOURCES OF THE NORTHERN HEMISPHERE,
R. K. Klige, and V. S. Kovalevskii.
Water Resources, Vol. 9, No. 3, p 263-271, May-June, 1982. 6 Fig, 1 Tab, 23 Ref. Translated from Vodnye Resursy, No. 3, May-June, 1982.

Descriptors: *Groundwater, *Water resources, *Groundwater recharge, Replenishment, Natural recharge, Water balance, USSR, Northern hemisphere, Groundwater depletion, Groundwater runoff.

To study the long term trend of recharge of groundwater resources, data was used of the indicated observations for the territories of the USSR, Europe, and the USA. The chronological runoff series were obtained on the basis of the mean monthly discharges of comparatively small rivers mainly for the winter low water period during which rivers are fed primarily by groundwaters. The data of more than 1000 gauging stations with a duration of observations from 15 to 80 years with the bulk of the series having a duration of 25-40 years were used for analyzing the groundwater regime. In the Leningrad region, Baltic region, Belorussia, and central regions of the RSFSR a distinct trend toward depletion of groundwater resources is noted in recent decades against the background of a periodic alternation of individual groups of dry and wet years. An analogous picture is found in the Maritime territory, Novosibirsk and Omsk regions, Georgia, and on the greater part of the territory of Kazakhstan. A trend toward an increase of groundwater resources was noted in some other areas including the southern Ukraine, Middle Volga Land, Ciscaucasia, and a number of regions of Central Asia, Kazakhstan, and Eastern Siberia. (Baker-IVI)
W84-02315

PREDICTION OF GROUNDWATER RESOURCES OF FOLD REGIONS ON THE BASIS OF STUDYING THE EVOLUTION OF ROCK PERMEABILITY,
B. E. Antypko.
Water Resources, Vol. 9, No. 4, p 370-380, July-August, 1982. 3 Fig, 1 Tab, 16 Ref. Translated from Vodnye Resirsy, No. 4, p 48-59, July-August, 1982.

Descriptors: *Groundwater basins, *Permeability, *Rocks, Mountains, Basins, Hydrogeology, Water storage, Groundwater storage, Seepage, Soil properties, Geologic history.

Some regional aspects of the formation and evolution of porosity and permeability of rocks in fold-mountain regions and basins within their limits are examined. In these regions the permeability of rocks is regarded as a complex function depending on such factors as the genesis of the rocks, evolution of sedimentary rocks in various stages of progressive lithogenesis, regional metamorphism of rocks during geosynclinal folding and orogenesis, local metamorphism with manifestations of volcanism and tectonic disturbances in postfolding epochs, and subsequent disintegration under the effect of tectonic forces and in the zone of hypergenesis. Fold systems differ from one another by the number of phases of development and time of their completion. In conformity with the folding phases three principal rock complexes are distinguished in their structure. The first complex is rocks of the ancient folded basement on which the given system was formed. The second is the main geosynclinal complex of the given system, represented by sedimentary and volcanic rocks which during development of the geosynclinal trough were repeatedly subjected to complex folding, intrusions and extrusions of magma and as a result were uplifted as mountain structures. The third, or orogenic structural stage, is related to the formation of intermontane basins and foredeeps accompanying uplifting of the geosyncline at the final phase of its development. On the basis of the relations established between the degree of lithification of sedimentary rocks composing fold-mountain regions and their structural tectonic history, a map has been compiled of the lithogenesis and permeability of rocks for these regions. (Baker-IVI)
W84-02320

DISTRIBUTION OF FRESH GROUNDWATERS IN THE EARTH'S INTERIOR,
N. A. Marinov.
Water Resources, Vol. 9, No. 4, p 380-387, July-August, 1982. 10 Ref. Translated from Vodnye Resursy, No. 4, p 60-68, July-August, 1982.

Descriptors: *Groundwater potential, *Drinking water, *Distribution, Semiarid regions, Arid regions, Permafrost, Geohydrology.

Freshwater resources are not as vast as one might imagine, amounting to 2-3% of all the water, salt and fresh, combined. The main structural formations of the earth's crust containing fresh groundwaters are fold-mountain regions, or hydrogeological massifs, platform and intermontane artesian basins, faults, and shelf zones of seas and oceans. Groundwater recharge of fold-mountain regions is accomplished mainly by infiltration of precipitation, condensation of moisture from air and melting of glaciers. The formation of fresh groundwaters and the regularities of their distribution in water-containing rocks of highlands are extremely complex and depend on many factors. Groundwater discharge is accomplished by evapotranspiration, the drainage system, and flow into adjacent artesian basins. The role of fresh groundwaters of hydrogeological fold regions in solving the problems of drinking water supply is small. In humid regions groundwaters are as a rule sufficient for domestic water supply and other needs. In arid and semiarid regions, fresh groundwaters are insufficient. They are also insufficient on large expanses in the permafrost region. The major cause of groundwater depletion is pollution. One of the main conditions of conservation of fresh groundwater resources will be their protection from depletion and pollution. (Baker-IVI)
W84-02321

USE OF FACTOR ANALYSIS FOR REGIONALIZING FOLD-MOUNTAIN REGIONS BASED ON CONDITIONS OF FORMATION OF THE GROUNDWATER RUNOFF,
B. I. Pisarskii, and A. P. Khaustov.
Water Resources, Vol. 9, No. 4, p 388-395, July-August, 1982. 4 Tab, 30 Ref. Translated from Vodnye Resursy, No. 4, p 69-76, July-August, 1982.

Descriptors: *Groundwater runoff, *Mountains, *Factor analysis, Water supply development, Fold mountains, Distribution, Mapping, Mongolia, USSR.

The regularities of the distribution and formation of the groundwater runoff in the Mongolo-Baikalian orogenfold system are considered, including Lake Baikal region, a considerable part of the trans-Baikal region, and the mountainous regions of Northern Mongolia. The first stage of the study consisted of small scale mapping and regional evaluation of natural groundwater resources and their distribution with respect to aquifer systems and formations. The second stage included regime observations and experimental works on representative river basins, making it possible to establish zonation in the distribution of groundwater runoff and to estimate the portion of its individual components and value of the main parameters of the groundwater runoff of various probabilities. The calculations of the principal and indirect indices determining the conditions of formation of groundwater runoff and the construction of a factor model have made it possible on the basis of a limited number or direct parameters (rate of groundwater runoff and coefficient of groundwater feeding and runoff) to accomplish medium-scale mapping of the groundwater runoff and to give an estimate without conducting long and costly field investigations and regime observations. (Baker-IVI)
W84-02322

USE OF HEAVY OXYGEN ISOTOPE CONCENTRATIONS WHEN STUDYING GROUNDWATERS OF KARSTIFIED CARBONATE ROCKS OF THE CRIMEAN MOUNTAINS,
Yu. B. Seletskii, V. D. Pribluda, V. A. Polyakov, N. V. Isaev, and A. V. Yakubovskii.
Water Resources, Vol. 9, No. 4, p 404-408, July-August, 1982. 1 Fig, 2 Tab, 11 Ref. Translated from Vodnye Resursy, No. 4, p 85-90, July-August, 1982.

Descriptors: *Groundwater recharge, *Karst hydrology, Geohydrology, Carbonates, Rocks, Soil properties, Oxygen, Precipitation, Residence time, Oxygen isotopes, Crimean Mountains, USSR.

Problems of groundwater formation were examined in one of the karstified regions of the Crimean mountains. The accepted fact that the content of stable hydrogen and oxygen isotopes in precipitation decreases with increases of height above sea level at which it falls was used as the basis for this study. The results obtained allowed the establishment of altitudinal isotope gradients for precipitation of the southern and northern slope; the confirmation of the dominant role of groundwater recharge at high elevations; the establishment of a greater residence time of groundwater in the hydrogeological systems of the southern slope compared to the northern slope; and the observance of a predominantly winter recharge of all investigated types of groundwaters and its greater role for the

southern slope than for the northern slope. Thus this first experience of using O-18 concentration for solving certain important problems of the hydrogeology of the Crimean mountains demonstrated the prospects of using natural isotopes as a tracer when investigating conditions of groundwater formation in karstified massifs. (Baker-IVI)
W84-02323

INVESTIGATION OF GROUNDWATER EXCHANGE PROCESSES IN THE BALTIC ARTESIAN BASIN,
V. G. Onufriev, A. V. Meskheteli, Yu. L. Ob'edkov, N. B. Anosova, and V. V. Romanov.
Water Resources, Vol. 9, No. 5, p 530-535, September-October, 1982. 2 Tab, 3 Ref. Translated from Vodnye Resursy, No. 5, p 123-128, September-October, 1982.

Descriptors: *Groundwater exchange, *Water exchange, *Baltic Artesian Basin, Artesian basins, Aquifers, Water supply, Radioisotopes.

A determination of the temporal characteristics of water exchange processes is important for establishing regularities of the formation of groundwaters. The Baltic artesian basin occupies an area of about 214000 sq km and completely encompasses Estonia, Latvia, and Lithuania, the Kaliningrad Region of the RSFSR, northern regions of the Belorussian SSR, and a part of Poland. In a geological structural aspect, the Baltic artesian basin belongs to the northwestern part of the Russian platform. Two hydrogeological series separated by a Cambrian clay stratum are clearly distinguished in the section of the sedimentary mantle. The Sventoji-Tartu aquifer system, having paramount importance for operating and prospective water supply, is developed within 60% of the entire area of the Baltic artesian basin. The system is represented by strata of fine- and medium-grained sands or sandstones and siltstones, including from 10 to 50% lenticular-occurring variegated clays. The water content of the rocks varies considerably both over the area of their distribution and in the section. About 30 determinations of the C-14 and T content in groundwaters of the Baltic artesian basin were carried out to study water exchange processes. The possibility of using radiocarbon and tritium for determining the portion of waters of different origin and travel time of waters in various regions of the basin was shown with reference to the groundwaters of the Baltic artesian basin. (Baker-IVI)
W84-02330

TRITIUM AND OXYGEN-18 IN NATURAL WATERS OF THE NORTHEASTERN CASPIAN REGION,
R. K. Shakhnova, V. V. Romanov, V. S. Brezgunov, and I. K. Morkovkina.
Water Resources, Vol. 9, No. 5, p 536-545, September-October, 1982. 3 Fig, 1 Tab, 7 Ref. Translated from Vodnye Resursy, No. 5, p 129-139, September-October, 1982.

Descriptors: *Groundwater recharge, *Radioisotopes, Tritium, Oxygen radioisotopes, Tritium, Caspian regions, Natural waters, Precipitation, Groundwater movement.

Isotopic characteristics of natural waters of the northeastern Caspian region were used to study the hydrodynamic conditions in the upper sedimentary strata of a section up to 100 m thick. The region under study included the Ural River valley in its meridional course, marginal northeastern part of the Caspian lowland, and the cis-Syrt spurs. The region is characterised by an arid climate, resulting in a deficit of surface waters and specific features of the relief complicated by the development of many meso- and microforms. Comparatively low values of tritium (T) and oxygen-18 (O-18) concentrations were noted in precipitation and river waters. Substantial differentiation of T concentrations was noted in river waters depending on the size of the rivers. Decreases of isotopic concentrations were seen in waters of small rivers from the upper reach to the mouth. Substantial increases were noted in T and O-18 concentrations in waters of lakes compared to river waters. A general trend toward a decrease of T and O-18 concentrations from surface waters and precipitation to groundwaters was noted. Within the region there is no unified groundwater flow, except the groundwater flow in the alluvial deposits having a lateral resultant direction. There is no regular recharge of lenses of fresh and slightly brackish waters in marine and eolian Quaternary deposits. The recharge of groundwaters by river waters occurs only within alluvial valleys of comparatively large rivers of the region. (Baker-IVI)
W84-02331

STUDY OF THE SULFUR ISOTOPIC COMPOSITION OF GROUNDWATERS FOR SOLVING HYDROGEOLOGICAL PROBLEMS (WITH SPECIAL REFERENCE TO THE CHU-SARYSU ARTESIAN BASIN),
G. M. Shor, M. N. Golubchina, N. I. Komarova, R. E. Prilutskii, and A. I. Toksubaev.
Water Resources, Vol. 9, No. 5, p 550-556, September-October, 1982. 6 Fig, 1 Tab, 8 Ref. Translated from Vodnye Resursy, No. 5, p 145-152, September-October, 1982.

Descriptors: *Groundwater, *Hydrogeology, Sulfates, Sulfur isotopes, Infiltration, Artesian basins, Geochemistry, Chu-Sarysu Artesian Basin, Kazakhstan, USSR.

The sulfur isotopic composition of sulfate in the formation waters of the Upper Cretaceous-Eocene strata of the central part of the Chu-Sarysu artesian basin in southern Kazakhstan (USSR) has been studied for more than 10 years. The results of the study can be used when solving the following specific problems: establishment of the sites of recharge of flows of present day infiltration waters; establishment of the characteristics of formation of fresh calcium and sodium-calcium waters localized in the sphere of influence of the main and secondary recharge areas of infiltration flows; establishment of the conditions of formation of saline sodium chloride-sulfate and sodium sulfate-chloride waters; evaluation of the possibility of the participation of biogenic processes in the formation of the chemical composition of groundwaters; and the establishment of the role of biogenic processes in the formation of soda-type groundwaters having special technical and irrigation properties. (Baker-IVI)
W84-02332

RADON SURVEY DETECTION OF SUBMARINE GROUNDWATER DISCHARGE ZONES,
P. A. Kir'yakov, G. V. Lisichenko, V. A. Emel'yanov, and A. Yu. Mitropol'skii.
Water Resources, Vol. 9, No. 5, p 557-561, September-October, 1982. 3 Fig, 1 Tab, 10 Ref. Translated from Vodnye Resursy, No. 5, p 153-157, September-October, 1982.

Descriptors: *Groundwater movement, *Radon, Submarine springs, Black Sea, Crimea, USSR, Water supply, Groundwater discharge.

The submarine discharge of fresh groundwaters in the shelf zone and continental slope of the Black Sea coast of Crimea was examined for water supply purposes. Two zones were selected for study. The first had previously known submarine discharges of fissure-karst waters. In the second zone the presence of such discharges was only assumed. The radon content in springs on the shore and in the sea were measured simultaneously along marked profiles to determine the background values of radon. The determination of groundwater discharge is possible not only under conditions of rivers but also in the sea. A decrease was also noted in salinity in the bottom layer of seawater, which was caused by submarine discharge of groundwaters contained in the alluvial deposits of the Voron River valley. The radon method is most effective under conditions of concentrated discharges. The use of this method together with hydrochemical, hydrodynamic, and thermometric investigations will permit a more effective estimation of submarine groundwater discharge. (Baker-IVI)
W84-02333

GROUND WATER AND THE EVOLUTION OF PATTERNED MIRES, GLACIAL LAKE AGASSIZ PEATLANDS, NORTHERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
D. I. Siegel.
Journal of Ecology, Vol. 71, No. 3, p 913-921, November, 1983. 3 Fig, 33 Ref.

Descriptors: *Groundwater movement, *Bogs, *Mire complexes, *Peat bogs, *Glacial Lake Agassiz, Minnesota, Computer models, Hydrogen ion concentration, Groundwater mounding, Fens, Wetlands, Geohydrology.

The hydrogeological setting of the Glacial Lake Agassiz Peatlands in Minnesota was investigated by measuring ground-water levels in observation wells, by studies of soil types and thicknesses, and by computer model experiments to simulate ground-water flow. Most ground water circulates along flow paths several kilometers long that pass through the peat column and into the underlying mineral soil. Most ground-water flow is probably caused by the development and persistence of large raised bogs, and occurs because of groundwater mounds (elevated water tables) under the bogs. Lateral bog growth may be limited by the neutralizing of bog water acidity by ground-water discharge ('artesian' flow) at raised bog margins. (Author's abstract)
W84-02401

EFFECT OF SPATIAL VARIATION IN HYDRAULIC CONDUCTIVITY ON GROUNDWATER FLOW BY ALTERNATE SOLUTION TECHNIQUES,
Birmingham Univ. (England). Dept. of Civil Engineering.
N. T. Kottegoda, and G. C. Katuuk.
Journal of Hydrology, Vol. 65, No. 4, p 349-362, September, 1983. 6 Fig, 3 Tab, 9 Ref.

Descriptors: *Groundwater movement, *Permeability coefficient, *Spatial distribution, Flow, Monte Carlo method, Permeability, Seepage, Drainage, Aquifer properties, Simulation, Statistical methods.

The behavior of an aquifer in which there is spatial variation in hydraulic conductivity is simulated by means of a Monte Carlo procedure. A second approach uses finite-difference methods to quantify the variance in potential head and flow through an aquifer. In the first method the lognormal function is used to model the distribution of conductivities. Thus variations in hydraulic head and specific discharge are studied. In the alternate technique the standard deviation of two-dimensional flows is related to the standard deviation of conductivity. Hence, an empirical probability distribution of flows is obtained by specific values of the variance in conductivities. Uncertainty concerning the predicted hydraulic head was dependent on the degree of non-uniformity in hydraulic conductivity as measured by its standard deviation. The variation in two dimensional flow in a confined medium was greater than the variation in hydraulic head, espcially for a medium with high conductivity values. A probability distribution of groundwater flows, in a medium with random lognormal conductivities was obtained by experimental methods. There was no particular benefit in using random walk procedures over numerical methods. In fact, finite-difference procedures took less computer time because the alternate solution technique required large sets of random numbers to obtain comparable results. However, more complicated three-dimensional analyses may be advantageously tackled by Monte Carlo methods. (Baker-IVI)
W84-02455

RECHARGE TO FINITE AQUIFERS FROM STRIP BASINS,
Indian Agricultural Research Inst., New Delhi. Water Technology Center.
N. H. Rao, and P. B. S. Sarma.
Journal of Hydrology, Vol. 66, No. 1-4, p 245-252, October, 1983. 3 Fig, 7 Ref.

Descriptors: *Aquifer recharge, *Recharge basins, *Groundwater recharge, Mathematical studies, Model studies, Aquifer characteristics, Basins, Recharge, Fourier analysis.

The problem of groundwater recharge from strip basins to finite aquifers is solved analytically by the method of finite Fourier transforms. Analytical solutions were derived for the profiles of water table mounds resulting from recharge over a strip basin to a finite aquifer for two different types of aquifer boundaries, namely, open-water-body boundaries, and impermeable boundaries. The results compare favorably with those experimental results conducted in sand tank models. The water table profiles predicted by the proposed theory agree with the experimental results and with the numerical solutions and are better than an earlier linearized analytical solution. (Baker-IVI)
W84-02469

2G. Water In Soils

ESTIMATION OF SOIL MOISTURE FROM SEASAT SAR DATA,
Texas A and M Univ., College Station. Remote Sensing Center.
B. J. Blanchard, and A. T. C. Chang.
Water Resources Bulletin, Vol. 19, No. 5, p 803-810, October, 1983. 10 Fig, 14 Ref. DOC contract M09-A01-78-00-4332, NASA grant NSG5-134.

Descriptors: *Soil water, *Radar, *Satellite technology, Remote sensing, Crops, Tillage, Vegetation, Synthetic Aperture Radar, Seasat.

A study was made to determine if Seasat Synthetic Aperture Radar (SAR) data could be used to make practical estimates of soil moisture. Extensive ground measurements were collected at two primary sites near Guymon, Oklahoma, and Sublette, Kansas. The relative sensitivity of the SAR to differences in soil moisture, tillage roughness, and vegetation was determined. To validate the effects detected in the SAR data, an airborne scatterometer with a similar wavelength was flown repeatedly over the Guymon site. Soil moisture variations in the surface 2 cm and surface 15 cm of fields with bare soil, milo and alfalfa produce similar responses in the scattering coefficient from both systems. Roughness due to tillage in row crops produced as much as 12-15 dB increase in the scatterometer return. Most agricultural vegetation was effectively penetrated by the L-band frequencies; however, corn produced an exceptionally high radar return either standing or after combine harvesting. When corn had ripened, there was some evidence that tillage roughness could be detected through the canopy. Moderate tillage roughness produced by grain drill furrows caused over 12 dB increase in return when row directions changed from parallel to perpendicular with respect to the SAR look direction. Dramatic increases in return occurred when vegetation surfaces were wet. Increased radar returns from tillage roughness, some vegetation and wet vegetation surfaces, all dynamic in nature, were significant and may limit the practical estimation of soil moisture from the radar data. (Author's abstract)
W84-02170

EFFECT OF SUBSOIL CONDUCTIVITY AND THICKNESS ON INTERFLOW PATHWAYS, RATES AND SOURCE AREAS FOR CHEMICALS IN A SLOPING LAYERED SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
L. R. Ahuja, and J. D. Ross.
Journal of Hydrology, Vol. 64, No. 1/4, p 189-204, July, 1983. 7 Fig, 2 Tab, 12 Ref.

Descriptors: *Saturated flow, *Soil properties, Permeability coefficient, Infiltration, Conductivity, Seepage lines, Transport, Fate of pollutants.

The effects of relative hydraulic conductivities and thickness of topsoil and subsoil layers and leakage rate of a compact base material on the saturated steady water flow through a sloping soil to an outflow face (interflow) were investigated theoretically. The water was assumed to be supplied from the surface, enough to keep the entire soil saturated. Simplified descriptions of the interflow characteristics were sought. A Gram-Schmidt orthonormalization procedure provided a potential-theory solution of the problem, even though the outflow seepage face existed over two soil layers. For a nonlayered soil two regions of water entry and flow could be distinguished when the base material was not leaky: flow in the main body of soil (region 1); and additional infiltration and flow near the seepage face (region 2). For a (slope length) / (soil depth) ratio of 20 or greater, the flow in region 1 could be approximated as a one-dimensional flow downslope in each soil layer. The length of slope that contributed to flow in region 2 was linearly related to the ratio of the hydraulic conductivity of the subsoil to that of the topsoil. A subsoil of higher conductivity than that of the topsoil increased several fold the rate of infiltration and interflow and the soil (both topsoil and subsoil) volume that was traversed by interflow near the seepage face. It also increased the area and rates of water entry and flow through the topsoil near the upper end of the slope. The transport of topsoil chemicals to field runoff will be speeded up from certain, now predictable, portions of the slope length. When the underlying base material was leaky, some water entering the soil surface seeped into the base material and the soil volume traversed by the interflow was greatly reduced. Amounts of chemicals carried to the outflow face would also be reduced. There were several situations of base leakage rates, soil conductivities and thickness considered. For leakage rates of practical interest, the source areas and the soil volume traversed by the interflow could be predicted adequately by a simple procedure. The total rates of water interflow in both the nonleaky- and leaky-base cases could be predicted adequately from known reference values of a nonlayered soil by using a weighted average hydraulic conductivity of the layered profile. For prediction of chemicals transported with interflow, knowledge of the flow directions and rate variation along the slope length will be required. (Baker-IVI)
W84-02208

VERIFYING THE EFFECT OF ACID PRECIPITATION ON SOIL LEACHATES: A COMPARISON BETWEEN PUBLISHED RECORDS AND MODEL PREDICTIONS,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
For primary bibliographic entry see Field 5B.
W84-02238

MODELLING THE EFFECTS OF ACID PRECIPITATION ON SOIL LEACHATES: A SIMPLE APPROACH,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
For primary bibliographic entry see Field 5B.
W84-02239

HYDRODYNAMIC DISPERSION DURING ADSORPTION OF WATER BY SOIL; I. MODEL SOIL-MOISTURE PROFILES,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
D. E. Elrick, M. J. L. Robin, and K. B. Laryea.
Journal of Hydrology, Vol. 65, No. 4, p 313-331, September, 1983. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Soil moisture, *Hydrodynamics, *Adsorption, *Dispersion, Soil properties, Model studies, Mixing.

Solute mixing during sorption of water is analyzed for three model soil-water profiles: a step-function profile, an error function complement profile and a curvilinear profile. The solution to the step-function profile showed that the plane about which salt dispersion occurs is coincident with the plane of separation which assumes that all of the water initially present is pushed ahead by the infiltrating water. For the two other model profiles, similar results were obtained using numerical analysis. A simplified approach for calculating these planes, based on the delta-function model is presented for both horizontal and vertical infiltration. The solute balance is maintained for all values of the dispersion coefficient for the flux-related boundary condition only. (Baker-IVI)
W84-02453

HYDRODYNAMIC DISPERSION DURING ABSORPTION OF WATER BY SOIL; 2. IMMOBILE WATER MODEL,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
M. J. L. Robin, K. B. Laryea, and D. E. Elrick.
Journal of Hydrology, Vol. 65, No. 4, p 333-348, September, 1983. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Absorption, *Soil water, *Model studies, *Dispersion, Diffusion, Soil profiles, Hydrodynamics, Immobile water.

The effect of an immobile-water fraction on the dispersion coefficient for a model soil moisture profile is described. If the immobile-water fraction is not accounted for in the formulation, the calculated dispersion coefficient may be higher than the diffusion coefficient of the solute in soil. The advantage of using the model soil profiles in analyses is that they cover the range of possible soil water behavior. Also the effect of immobile water can be examined without any interference from the effects of other phenomena such as anion exclusion, and from experimental problems. Three model soil-water profiles were used in this study having different immobile-water contents up to 0.08 cu m/cu m. Increasing the immobile water content decreased and shifted the average concentration profiles further into the soil. The values of the dispersion coefficient calculated with the immobile water fraction ignored were found to be water content dependent and many times greater than that of the input dispersion coefficient. (Baker-IVI)
W84-02454

2H. Lakes

ROLE FOR SEDIMENTS IN RETARDING THE ACIDIFICATION OF HEADWATER LAKES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and J. R. M. Kelso.
Water, Air, and Soil Pollution, Vol. 20, No. 4, p 379-389, November 1983. 5 Fig, 3 Tab, 17 Ref.

Descriptors: *Acidification, *Headwater lakes, *Sediments, *Buffering, Lakes, Hydrogen ion concentration, Calcium, Magnesium, Ontario.

In order to assess the major effects of acidification on sediments, hydrochloric acid was added to aqueous sediment and mineral slurries, and the samples were shaken for a few days. After centrifugation the supernatants were analyzed for Ca, Mg, Al, Fe, Na, K, and pH. Major acid neutralization reactions above pH 4.5 were reactions releasing Ca(2+) and Mg(2+) from the sediments. Analysis of the sediments and water from 97 headwater lakes in northern Ontario showed a predictable decrease in the exchangeable Ca(2+) + Mg(2+) of the sediments with decreasing lakewater pH. Estimates of the total potential buffering capacity for the sediments above PH 4.5 and for water in these headwater lakes were made, and it was found that, even when only the top 1 cm of sediment is considered, a substantial sediment buffering reserve is available. (Moore-IVI)
W84-02137

SOME ASPECTS OF THE UNDERWATER LIGHT CLIMATE OF A REGULATED RIVER,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
W. Kopf.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 5, p 168-172, 1983. 7 Fig, 9 Ref.

Descriptors: *Solar radiation, *Photosynthetically active radiation, Water surface, Regulated rivers, Phytoplankton, Suspended solids, Chlorophyll-a.

The loss of PAR (Photosynthetically Active Radiation) due to reflection at the surface of a regulated river averages 10% when measured with an area sensor with cosine response and 25% using a 4-pi spherical quantum sensor. During the vegetation period the monthly average of PAR ranges from 20-35 E/sq m/d when measured with the 4-pi spherical quantum sensor under the water's surface. The role played by diffused underlight is important for the PAR used by photoplankton. This is in accordance with the vertical profile of the spherical quantum sensor as compared to the cosine-area sensor. Suspended matter and phytoplankton (expressed as chlorophyll-a) have a substantial influence on the transmission of PAR in water. The extinction-coefficient can be dissected into a suspended matter portion and a chlorophyll-a-dependent portion using a multiple linear regression analysis. The extinction-coefficient Es (spherical sensor) is significantly correlated to the dry-weight of suspended matter and the concentration of active chlorophyll-a. (Author's abstract)
W84-02141

SENSITIVITY OF PHYTOPLANKTON SIMULATIONS TO VARIATIONS IN THE HALF SATURATION CONSTANTS,
Nevada Univ. System, Las Vegas. Desert Research Inst.
R. H. French.
Water Resources Bulletin, Vol. 19, No. 5, p 729-733, October, 1983. 5 Fig, 1 Tab, 9 Ref.

Descriptors: *Phytoplankton, *Simulation, *Michaelis-Menten constant, *Reservoir restoration, Water quality, Chlorophyta, Cyanophyta, Phosphorus, Limiting nutrients.

In many impoundment dynamic water quality models, the growth of two or more ecologic groups of phytoplankton may be simulated. These ecologic groups are differentiated by growth rates, temperature tolerances, settling rates, and the Michaelis-Menten half saturation constants for necessary nutrients. The effect of misestimating the Michaelis-Menten half saturation constant (K) for the limiting nutrient (phosphorus) when two competing ecological groups of algae (blue-green and green) are simulated is examined. In an idealized case, uncertainty in the half saturation coefficient for the limiting nutrient for one ecological group of algae can significantly affect the simuation results and in some cases could lead to a poorly designed impoundment restoration program. For the conditions chosen in this example, the relative magnitude of K (phosphorus) for bluegreen or green algae determined which species of algae was dominant. If K for bluegreen algae is less than K for green algae, then the restoration will not achieve its goal. (Moore-IVI)
W84-02160

LIMNOLOGY OF LAKE WABUKAYNE, A STORM-WATER IMPOUNDMENT,
Environmental Council of Alberta, Edmonton.
B. M. Free, and G. G. Mulamoottil.
Water Resources Bulletin, Vol. 19, No. 5, p 821-827, October, 1983. 4 Fig, 4 Tab, 20 Ref.

Descriptors: *Detention reservoirs, *Stormwater, *Eutrophication, Nutrients, Photosynthesis, Phytoplankton, Dissolved oxygen, Construction, Turbidity, Salt, Chlorides, Meromixis, Invertebrates, Seasonal variation.

The limnology of a 1.9-ha storm-water detention pond is described. The eutrophic nature of this impoundment is attributed to the nutrients in runoff from the surrounding residential area. During the summer, photosynthetic activity of the phytoplankton caused surface waters to become super-saturated with oxygen, while decomposing organic material greatly reduced dissolved oxygen concentrations in the deeper water. Sediment derived from construction activity within the drainage basin caused the impoundment to be turbid. The use of road deicing salts within the drainage basin produced high chloride concentrations and a temporary meromixis during the winter and early spring. The benthic fauna consisted primarily of oligochaetes, chironomids, and chaoborids. High densities of oligochaetes were present in the settling basin. Chaoborid larvae were abundant in the deep basin where low oxygen concentrations reduced the numbers of other benthic macroinvertebrates. (Author's abstract)
W84-02172

AGGREGATION OF VARIABLES IN SIMULATION MODELS OF WATER ECOSYSTEMS,
N. E. Luckyanov, Yu. M. Svirezhev, and O. V. Voronkova.
Ecological Modelling, Vol. 18, No. 3/4, p 235-240, April, 1983.

Descriptors: *Simulation, *Mathematical models, *Ecosystems, Variable aggregation, Aquatic life, Theory, Model studies.

One of the most difficult problems of ecological systems modelling is that of dimension. Even such a comparatively simple object as an oligotrophic waterbody has more than 80 types of zooplankton, 350 types of benthos, about 50 types of fish, etc. To decrease model dimensions, it is necessary to make variable aggregation, to unite some variables of the system that are related to one another into some sort of blocks each of which is a new variable with the properties defined by the aggregation laws. Usually one accepts the hypothesis that the aggregated variables are simple sums of the constituent variables, and one considers that the law of the aggregated variables' interaction is the same as the law for the nonaggregated interaction, but this is not true. The model often loses its property of parametrical universality. Two theorems are developed which give one an opportunity to obtain some criteria of aggregation for models of water ecosystems that are described by a system of differential equations. Founded on the theory of variable aggregation, the idea was formulated that it was reasonable to take piecewise linear functions as trophical functions for water ecosystems. (Moore-IVI)
W84-02235

STRUCTURE AND FUNCTION OF A WARM MONOMICTIC LAKE,
Florida Univ., Gainesville. School of Forest Resources and Conservation.
K. C. Ewel, and T. D. Fontaine, III.
Ecological Modelling, Vol. 19, No. 2, p 139-161, June, 1983. 14 Fig, 3 Tab, 52 Ref.

Descriptors: *Monomictic lakes, *Ecosystems, *Simulation, Biomass, Aquatic plants, Nutrient cycling, Phytoplankton, Zooplankton, Food chains, Model studies, Lake Conway, Florida.

Construction and simulation of a model of Lake Conway, Florida, U.S.A., provided a framework for defining major characteristics of this ecosystem. The relationships that are formalized in this model comprise a set of hypothesis about the nature of a warm monomictic lake. The data that were used to parameterize the model came primarily from literature estimates, although approximations of biomass levels were available from associated research conducted on the lake. Submersed macrophytes are a major biomass component in Lake Conway; simulation suggested that their role in nutrient recycling overshadows their importance in the grazing food chain. Phytoplankton biomass and degree of fluctuation are considerably lower than are observed in most cool temperature lakes, although simulated respiration and herbivory rates are closer to temperate values than tropical values. Simulated epipelic algae biomass varies an order of magnitude during the year, and this group appears to be a significant part of the food chain. Simulated zooplankton consumption and turnover rates are very high, in part because of the relatively small biomass per individual. Simulation of the model suggests that slightly more carbon is processed through the grazing food chain in Lake Conway than through the detritus food chain. (Author's abstract)
W84-02237

TEST OF TWO MODELS OF DIFFERENT LEVELS OF COMPLEXITY FOR PREDICTING CHANGES OF PHOSPHORUS CONCENTRATION IN A LAKE'S OUTFLOW,
McMaster Univ., Hamilton, Ontario. Dept. of Civil Engineering.
W. J. Snodgrass, and P. J. Dillon.
Ecological Modelling, Vol. 19, No. 3, p 163-187, July, 1983. 9 Fig, 1 Tab, 16 Ref.

Descriptors: *Phosphorus, *Mathematical models, *Outflow, Hydraulic loading, Temporal distribution, Stratification, Lakes, Canada.

The objective of this investigation is to compare the ability of a one-box model and a two-box model to predict the temporal variations of total phosphorus in the outflow of several lakes. The one-box model considers only total phosphorus and treats the lake as well-mixed, all year round. The two-box model considers two phosphorus fractions and the epilimnion and hypolimnion. For five shallow Canadian Shield lakes, some of the temporal variability in lake phosphorus concentrations can be explained on the basis of changes in hydraulic inflows and phosphorus loadings. Both models give roughly similar predictions for shallow lakes with high hydraulic loadings (1-200 m/year) and small variations in total phosphorus concentrations. In comparing the settling and hydraulic outflow mechanisms, a sensitivity analysis shows that both models are more sensitive to the settling rate if the lake's hydraulic loadings are less than 1 m/year, and more sensitive to the outflow rate if the lake's hydraulic loadings are greater than 100 m/year. This analysis suggests a priority for concentrating economic and other resources in conducting field measurement programs for testing phosphorus models. (Author's abstract)
W84-02240

SUSPENSOID CHARACTERISTICS IN SUBALPINE CASTLE LAKE, CALIFORNIA; II. OPTICAL PROPERTIES,
DSIR, Taupo (New Zealand). Div. of Marine and Freshwater Science.
J. C. Priscu.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 425-433, August, 1983. 1 Fig, 2 Tab, 22 Ref.

Descriptors: *Suspensoids, *Light extinction, *Castle Lake, *California, *Optical properties, Chlorophyll, Particulate matter, Dissolved solids, Plankton, Photosynthesis, Hypolimnion, Epilimnion, Cirque lakes, Solar radiation.

The epilimnetic and hypolimnetic waters in Castle Lake, a small meso-oligotrophic cirque lake in northern California, were analysed with respect to their properties of light extinction. The vertical extinction of downwelling photosynthetically available radiation (PAR) was partitioned into that caused by chlorophyll, non-chlorophyllous particulate matter, dissolved substances, and that due to the water alone through a modification of the Beer-Lambert model. Over 65% of the total light extinction was caused by nonchlorophyllous suspensoids in both epilimnetic and hypolimnetic waters. The relative extinction of light by chlorophyll was approximately 10 and 20% for epilimnetic and hypolimnetic water layers, respectively, and delineates the deep-phytoplankton maximum that exists in Castle Lake. Dissolved substances accounted for less than 2% of the PAR at the depths studied; the remaining extinction was caused by the water alone. The large background extinction in Castle Lake may act to restrict integral rates of photosynthesis to less than 20% of the potential upper limit. (Author's abstract)
W84-02244

LIGHT CONDITIONS IN LAKE ZURICH, 1980/81; PART II: SURFACE EFFECTS,
Hydrobiologische-limnologische Station, Kilchburg (Switzerland).
F. Schanz.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 501-508, August, 1983. 3 Fig, 16 Ref.

Descriptors: *Solar radiation, *Surface effects, *Lake Zurich, Back radiation, Light penetration, Wave action, Back radiation, Clouds.

Weekly measurements of light intensity above and below the surface of the Lake Zurich were carried out during the period 1980/81 in order to study the short-wave back radiation (400-700 nm), and the fraction of incident light which penetrates into the water. Back radiation on cloudy days remains more or less constant at 5.4% of incident light. On non-cloudy days back radiation decreases with increasing incident light intensity, mainly as a result of the decrease in reflected light with increasing solar declination. A linear relationship between solar declination and albedo (back radiation as a percentage of incident radiation) was found in the range 20 to 56 degrees of sun elevation. From April to September, as a result of the approximately constant solar declination, the albedo is determined in the main by the amount of suspended material in the upper 5 m. The relationship between the light intensity measured above the surface and that measured below the surface was found to be linear from 0.05 to 1.00 mE/sq m/s and also from 1.01 to 2.10 mE/sq m/s. The mean energy loss at the surface based on all available data amounted to 7%. Wave action reduces losses in light energy at the surface on cloudy days. On overcast days it can be assumed that the light data measured with either a smooth or rough lake surface belong to the same population. This allows a determination of the influence of waves on surface loss: 16% was calculated for a smooth surface and 11% for a rough surface. (Moore-IVI)
W84-02245

FISHERIES SITUATION IN THE PERUVIAN AMAZON REGION (ZUR SITUATION DER FISCHEREI IM PERUANISCHEN AMAZON-ASGEBIET),
Konstanz Univ. (Germany, D.R.). Limnologische Inst.
V. R. Eckmann.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 509-539, August, 1983. 6 Fig, 6 Tab, 32 Ref.

Descriptors: *Fisheries, *Amazon Region, *Loreto, *Peru, Fish, Water level fluctuations, Fish management, Fish farming, Aquaculture.

The fisheries in the Peruvian Department of Loreto are characterized according to the fish fauna, fishing methods, preservation and transport techniques. Only 30 out of the approximately 2000 Amazonian fish species are suitable for human consumption. Method of preservation, transport, and storage still need improvement and therefore mass catches cannot be sold completely. Recent qualitative changes in the fish supply of the capital of Loreto, Iquitos, can be attributed to an intensive exploitation of fish stocks. Microphagous species are prevalent in the supply for the urban centers while in rural areas herbivorous and carnivorous species predominate. The extreme fluctuations in catches of the most important microphagous characin, Prochilodus cf. nigricans, are dependent on water level fluctuations. It is impossible to register completely the fish yields in this region; totals are estimated at 34,000 tons for 1980. By including new species, intensifying the fishing of siluroid species and by exploiting microphagous species in remote regions, total fish yields could be increased. Aquaculture could help to improve the supply of fish protein for the larger cities as well as for the rural population. Fish farms in the transition zone between the lowlands and the Andes could help to diminish fish exports from the Amazon region to into this zone. (Moore-IVI)
W84-02246

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES; VII BUSHMANS, KARIEGA, KOWIE AND GREAT FISH RIVERS,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W84-02306

TRANSPORT OF MATTER AND ENERGY IN A STRATIFIED EUTROPHIC LAKE AND ITS CHANGE UNDER AN EXTERNAL EFFECT,
V. F. Brekhovskikh, and I. A. Korneev.
Water Resources, Vol. 9, No. 4, p 356-363, July-August, 1982. 3 Fig, 2 Tab, 13 Ref. Translated from Vodnye Resursy, No. 4, p 27-35, July-August, 1982.

Descriptors: *Eutrophication, *Lakes, *Sediment transport, *Energy, Thermoclines, Temperature effects, Stratification, Dissolved oxygen, Diffusion, Lake Medvezh'e, USSR.

An attempt was made to determine, by calculation, the coefficients of diffusivity and diffusion of dissolved oxygen in the thermocline and hypolimnion of a stratified eutrophic lake in which summer artificial aeration was carried out. The investigations were conducted on Lake Medvezh'e outside Moscow (USSR) with a water volume of 315,000 cu m, surface area of 11 ha, and maximum depth of 8.6 m. The lake is surrounded by forests and has the shape of an almost regular circle. The data obtained allow the conclusion that the values of the coefficients of diffusivity and diffusion are close to molecular during the stagnation period in the thermocline of the lake. A noticeable eddy component appears in the lower part of the thermocline, which becomes dominant in the hypolimnion. During artificial aeration that thermocline is eroded, heat and mass exchange between the epilimnion and hypolimnion increased, but the values of the coefficients of the diffusivity and diffusion of oxygen indicate that before homothermy is reached the transport of heat and matter in the hypolimnion, as usual, is determined mainly by vertical turbulence. (Baker-IVI)
W84-02351

ENRICHED C-13 COMPOSITION OF INTERSTITIAL WATERS IN SEDIMENTS OF A FRESHWATER LAKE,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. V. Turner, and P. Fritz.
Canadian Journal of Earth Science, Vol. 20, No. 4, p 616-621, April, 1983. 3 Fig, 1 Tab, 25 Ref.

Descriptors: *Interstitial water, *Lake sediments, *Carbon radioisotopes, Bacteria, Sediments, Lakes, Methanogenesis, Ontario, Little Lake, Carbonates, Carbon dioxide, Hydrogen ion concentration.

The dissolved inorganic carbon of interstitial waters from sediments of a small carbonate-precipitating lake in southern Ontario has highly enriched C-13 values. This post-depositional isotopic enrichment is attributed to the metabolism of methanogenic bacteria. As methanogenic bacteria produce metabolic carbon dioxide, the pCO2 of the interstitial waters increases and pH decreases. The H(+) generated is buffered by carbonate dissolution, leading to the observed increase in Ca and carbonate alkalinity with depth. A decline in bacterial activity, possibly during winter months, would be accompanied by a decrease in pCO2 and increasing pH. Subsequent supersaturation of the interstitial waters with respect to calcite could lead to precipitation and incorporation of dissolved inorganic carbon enriched in C-13 in the marl. Data which show the interstitial waters at or very close to saturation with respect to calcite at high pCO2 are consistent with this theory. Such freshwater carbonate sediments with interstitial waters enriched in C-13 provide a unique environment for study of isotope relations during carbonate diagenesis under accessible conditions and with a time scale of geologic relevance. (Baker-IVI)
W84-02365

TROPHIC RESOURCE ALLOCATION BETWEEN PERCINA SCIERA AND P. OUACHITAE IN THE TOMBIGBEE RIVER, MISSISSIPPI,
Mississippi State Univ., Mississippi State. Dept. of Biological Sciences.
G. L. Miller.
American Midland Naturalist, Vol. 110, No. 2, p 299-313, October, 1983. 7 Tab, 59 Ref.

Descriptors: *Aquatic habitats, *Species composition, Trophic level, Rivers, Morphology, Tombigbee River, Mississippi, Species diversity, Darters, Aquatic habitats.

Aspects of trophic ecology of Percina sciera and P. ouachitae from a site on the Tombigbee River, Mississippi, were compared to determine the extent of seasonal, sexual and size class trophic allocation in the two species; describe the feeding habitats of the two species and compare these habitats to a syntopic group of benthic fishes, and determine whether a relationship exists between predator morphology and prey characteristics. The two species had similar diets which corresponded closely to diets for darters of similar habitats. There were small qualitative differences in diet, and gut content changed seasonally in both species. Percina sciera took larger prey than P. ouachitae in the autumn, and this was related to differences in fish size (standard length). Males and females differed in prey size selectivity and the differences were greatest in the spring. With the exception of standard length, no morphological trait of the two species was highly correlated with prey size. Trophic competition is likely of minor importance between these species. (Author's abstract)
W84-02375

SURVIVORSHIP AND PARASITE-INDUCED HOST MORTALITY AMONG MOSQUITOFISH IN A PREDATOR-FREE, NORTH CAROLINA COOLING RESERVOIR,
Wake Forest Univ., Winston-Salem, NC. Dept. of Biology.
W. O. Granath, Jr., and G. W. Esch.
American Midland Naturalist, Vol. 110, No. 2, p 314-323, October, 1983. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Population dynamics, *Fish, *Reservoirs, Mosquitofish, Aquatic habitats, Mortality, Parasites, Population dynamics, Water temperature, Predation.

Survivorship of mosquitofish infected with the pseudophyllidean tapeworm Bothriocephalus acheilognathi was significantly reduced as compared with uninfected mosquitofish when fish were held at temperatures of 20, 25, and 30 C. Survivorship of infected and uninfected fish was also significantly reduced as water temperatures were increased to 25 and 30 C. When mosquitofish were maintained at 25 C, larger individuals with lower parasite densities survive longer than smaller individuals with higher densities of the cestode. Pearson correlation and multiple regression analyses of survival time of Gambusia affinis on density of Bothriocephalus acheilognathi and total host length indicate that survivorship is a function of parasite density and host size. Certain demographic characteristics of mosquitofish populations in a system devoid of piscivorous predators (but with B. acheilognathi) were compared with those in a system having piscivorous predators (but without B. acheilognathi). Random samples of mosquitofish taken monthly from the two systems revealed no significant differences in either sex ratios or in mean lengths of male or female mosquitofish. The Krumholz (Int. Rev. Gesamten Hydrobiol., 48:201-256. 1963) predation hypothesis would predict otherwise, to wit, that sex ratios in the predator-free system should be 1:1 (with predators, sex ratios should be approximately 1 male: 2 females) and that both males and females should be significantly larger than males and females in a system possessing a full complement of piscivorous fishes. It is hypothesized that similarities among demographic features of mosquitofish populations in the two systems investigated in the present study are the result of parasite-induced, size-selective host mortality in the predator-free system on the one hand and of predation pressure from piscivorous fishes on the other. (Author's abstract)
W84-02376

EFFECTS OF SUSPENDED SILT ON FEEDING AND REPRODUCTION OF DAPHNIA PULEX,
Kansas Univ., Lawrence. Dept. of Systematics and Ecology.
C. D. McCabe, and W. J. O'Brien.
American Midland Naturalist, Vol. 110, No. 2, p 324-337, October, 1983. 8 Fig, 39 Ref.

Descriptors: *Zooplankton, *Suspended sediments, *Silt, *Feeding, *Reproduction, *Daphnia, Turbidity, Lakes, Clay, Aquatic habitats, Population dynamics.

The effects of suspended silt on the feeding and reproduction of Daphnia pulex and the impact of suspended silt and clay on freshwater zooplankton community structure were investigated. The effects of suspended silt and clay on the filtering and assimilation rates of Daphnia pulex were determined using a C-14 radiotracer method. Both filtering and assimilation rates are severely depressed at even low concentrations of suspended silt and clay. Life table studies also showed population growth rate of zooplankton was significantly diminished by suspended silts and clays. The relative abundance of zooplankton varied markedly between two lakes of differing turbidity levels, the more turbid lake having a higher relative abundance of large zooplankton species. Suspended silt and clay reduced zooplankton feeding and production. Zooplankton production was reduced by as much as 16 times that possible in nonturbid water. These effects, combined with the fact that high levels of suspended silts and clays reduce the photic zone and thus the potential primary productivity, also reduced the ability of planktivorous fish to find their prey. Thus turbidity may greatly reduce the trophic efficiency and productivity of affected lakes and reservoirs. (Baker-IVI)
W84-02377

LIFE HISTORY AND DISTRIBUTION OF THE ROANOKE BASS AMBLOPLITES CAVIFRONS COPE, IN VIRGINIA,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
H. J. Petrimoulx.
American Midland Naturalist, Vol. 110, No. 2, p 338-353, October, 1983. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Fish, *Population dynamics, Bass, Environmental effects, Drainage basins, Seasonal variations, Virginia, Roanoke, Chowan.

The life history and Virginia distribution of the Roanoke bass Ambloplites cavifrons Cope was studied from January 1979 through January 1980. Populations in the Roanoke and Chowan drainages were disjunct and locally uncommon, possibly owing to the patchiness of suitable physical habitat. Growth of male and female Roanoke bass was similar and significantly greater when compared with northern rock bass Ambloplites rupestris and redbreast sunfish Lepomix auritus. Ponderal indices were similar for both sexes and age dependent. Young A. cavifrons consumed small aquatic invertebrates; juveniles included crayfish and fish in the diet; adults ate predominantly crayfish. Seasonal diet variation was greater among juveniles than adults. Maturity occurred at age II if 150 mm TL and 75 g body weight had been attained. The reproductive season extended from May through June as water temperatures approached 20 C. Fecundity estimates exhibited a linear relationship to length and weight. Evidence of widespread year-class failure in 1978 and 1979 was attributed to adverse spring stream conditions. Ecological and environmental impacts have caused a recent decline in Roanoke bass abundance, warranting the species the conservation status of Special Concern. (Author's abstract)
W84-02378

INVESTIGATIONS ON ZOOPLANKTON AND ZOOBENTHOS IN THE LITTORAL OF A NEWLY BUILT RESERVOIR (ZOOPLANKTON- UND ZOOBENTHOSUNTERSUCHUNGEN IM LITORAL EINER NEUENTSTANDENEN TALSPERRE (TWISTETALSPERRE, NORDHESSEN)),
Kassel Univer. (Germany, F.R.). Inst. fur Zoologie/Limnologie.
W. Meinel, U. Matthias, and B. Schade.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 145-162, June, 1983. 8 Fig, 3 Tab, 23 Ref.

Descriptors: *Reservoirs, *Aquatic life, *Littoral environment, *Zooplankton, *Zoobenthos, Plankton, Twistetalsperre, Hesse, West Germany.

The first settlement of zooplankton and zoobenthos was investigated qualitatively and quantitatively in the littoral of a newly built reservoir (Twistetalsperre, Hesse, Federal Republic of Germany). In front of the main reservoir a preimpoundment basin, which has already been in operation for four years, is situated. Most of the plankton and benthos living in the main reservoir was also found in the preimpoundment basin. However, the settlement of the new reservoir in the first year was less than in the preimpoundment basin concerning the number of species and individuals. (Author's abstract)
W84-02382

NITROGEN METABOLISM IN LAKE KIZAKI, JAPAN; IV. AMMONIUM MAXIMUM LAYER IN THE METALIMNION,
Nagoya Univ. (Japan). Water Research Inst.
M. Takahashi, and Y. Saijo.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 180-195, June, 1983. 6 Fig, 19 Ref.

Descriptors: *Nitrogen, *Metabolism, *Limnology, Lake, *Kizaki, *Japan, *Ammonium, Metalimnion, Thermocline, Thermal stratification, Nitrification, Mathematical models, Phytoplankton.

In Lake Kizaki, the ammonium maximum layer was observed in the metalimnion during July to October in 1977. This layer was observed in the depth just below the trophogenic layer. The thickness of this layer was about 3 m, and the highest concentration was 13.9 microgram atom/liter. In order to explain the mechanism of the development and maintenance of the ammonium maximum layer, a simple numerical two-dimensional model with biological and physical parameters obtained in the previous study in this series is used to simulate the vertical distributions of ammonium in the metalimnion. At the depth where the maximum layer developed, the production of ammonium was superior to its consumption. This depth was in the stable thermocline. The physical transport of ammonium by eddy diffusivity was minimal. Therefore, the major part of ammonium produced was accumulated in this depth. Above this layer phytoplankton assimilation of ammonium exceeded the production of ammonium. Below this layer the consumption of ammonium through the nitrification process exceeded its production. (Baker-IVI)
W84-02383

QUANTITATIVE STUDIES ON CHIRONOMIDAE AND OLIGOCHAETA IN THE BENTHOS OF LAKE BALATON,
Hungarian Academy of Sciences, Tihany. Biological Research Inst.
J. E. Ponyi, I. Tatrai, and A. Franko.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 196-207, June, 1983. 7 Fig, 3 Tab, 38 Ref.

Descriptors: *Benthos, *Lakes, *Midges, *Oligochaetes, *Lake Balaton, Hungary, Annual distribution, Eutrophic lakes, Mesotrophic lakes, Biomass.

The biomass of Chironomidae larvae and Oligochaeta, its changes during various years and distribution in Lake Balaton (Hungary) are described. The biomass of the larvae of chironomids was about 5 to 8 times higher in the eutrophic basin than in the mesotrophic one (monthly means 1.2-4.2 and 0.25-0.49 g/sq m in dry weight, respectively). The 2 to 3 maxima of chronomid biomass, observed in Lake Balaton, seems to be typical for shallow eutrophic lakes. The biomass of chironomid has increased in the eutrophic part of the lake by three times between 1960-76, however it did not change in the other parts of Lake Balaton. The biomass of oligochaetes was the highest immediately beside the edge of the reed belt (3.7 g/sq m dry weight) and lowest (1.7 g/sq m) in the central part of the lake. The biomass of oligochaetes surpassed in the eutrophic basin that of the mesotrophic one only by 1.4 times. (Author's abstract)
W84-02384

TUBIFICIDAE OF THE LITTORAL OF LAKE CONSTANCE, REGARDING ESPECIALLY POTAMOTHRIX MOLDAVIENSIS (DIE LITORALEN TUBIFICIDAE DES BODENSEES MIT BESONDERER BERUCKSICHTIGUNG VON POTAMOTHRIX MOLDAVIENSIS),
P. Frenzel.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 262-280, June, 1983. 6 Fig, 2 Tab, 51 Ref.

Descriptors: *Tubificids, *Distribution, *Reproduction, *Water pollution effects, Eutrophication, Lumbriculids, Lake Constance, Water temperature, Depth.

Parallel with man-made eutrophication the community of Tubificidae and Lumbriculidae in the littoral of the western part of Lake Constance has changed. Immigration of species has not taken place. Depth distribution, interspecific affinities, and time of reproduction of most species are described. In 1977/1978, eleven species of Tubificidae could be found in the vicinity of Insel Mainau in the western part of Lake Constance. According to their depth distribution Tubifex tubifex, T. ignotus, Potamothrix moldaviensis and P. hammoniensis show a preference for the littoral, and Peloscolex ferox and Psammoryctides barbatus for the littoriprofundal; in Limnodrilus hoffmiesteri no clear trend could be found. The fauna in 1977/1978 is very different from that found in the same area in 1936/1937, with changes in frequency, the disappearance of some species, and the spread of some species present in locally polluted area in 1937. One possible explanation for the annual pattern of reproduction for Potamothrix moldaviensis is that the birth rate is not as strongly retarded by low temperture as the hatching rate is. This will lead to an accumulation of the progeny in the egg-phase during winter and to a synchronization of the population by means of the annual temperature regime. (Moore-IVI)
W84-02386

INFLUENCE OF WATER LEVEL, HUNTING PRESSURE AND HABITAT TYPE ON CROCODILE ABUNDANCE IN THE FLY RIVER DRAINAGE, PAPUA NEW GUINEA,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. J. Montague.
Biological Conservation, Vol. 26, No. 4, p 309-339, 1983. 7 Fig, 9 Tab, 41 Ref.

Descriptors: *Crocodiles, *Papua New Guinea, *Water level, *Hunting, Juvenile growth stage, Behavior, Swamps, Flooding, Strickland River, Burnett River.

Between October 1978 and July 1980, day and night crocodile surveys were conducted at low, normal and high water levels over 2703 km of river and lakeshore in the Western and Southern Highlands provinces of Papua New Guinea. The 1353 crocodiles seen ranged between 0.18 and 2.23 animals per km. Night counts recorded 12.9 times as many crocodiles as day counts over the same area. This may indicate more nocturnal activity than occurs in other crocodilians. Unhunted areas had a greater proportion of large crocodiles than did hunted regions. As the water level rose, the 'visible juveniles' category decreased as a result of migration into newly flooded adjacent swamplands. The upstream range of New Guinea crocodiles on the Strickland River extended only to the Burnett River junction. There was an increase in flight distance (wariness) with increasing body size and this rate of increase was over twice as large for hunted populations as for unhunted ones. (Author's abstract)
W84-02387

PHOTOSYNTHETIC INORGANIC CARBON USE BY FRESHWATER PLANTS,
The University, St. Andrews (Scotland). Dept. of Botany.
S. C. Maberly, and D. H. N. Spence.
Journal of Ecology, Vol. 71, No. 3, p 705-724, November, 1983. 9 Fig, 1 Tab, 58 Ref.

Descriptors: *Aquatic plants, *Phytoplankton, *Carbon dioxide, *Bicarbonate, Seasonal variation, Inorganic carbon, Alkalinity, Photosynthesis, Lakes.

A pH-drift technique was used to calculate free CO2 (CO2*) and bicarbonate, HCO3(-), compensation points for a range of freshwater macrophytes and phytoplankters. Some half-saturation constants for CO2 uptake were also estimated. The validity

of the technique and interpretation is generally confirmed. Variation in the CO2* compensation point of Hippuris vulgaris was related to the oxygen concentration of the bathing medium, and seasonal changes in HCO3(-) compensation point were found in Potamogeton filiformis and in HCO3(-) and CO2* compensation points in Elodea canadensis. The performance of these two macrophytes is probably affected more by seaonal changes in HCO3(-) compensation points than by CO2* compensation points. The quotient of total carbon remaining at the end of a pH-drift experiment to the constant alkalinity of the solution (Ct/Alk) was used as a measure of the uptake ability of a species. Ranked by this criterion, species showed a fairly continuous range in uptake ability with a nearly fifteen-fold difference between the most efficient (low quotient) and least effluent (high quotient) species. Although the uptake abilities of macrophytes and phytoplankters overlapped, the four most efficient carbon extractors were phytoplankters, and the nine least efficient were macrophytes. Anabaena cylindrica, Microcystis aeruginosa and Scendesmus quadricauda removed more than 90% of the available carbon compared with 70% for the most efficient macrophytes tested (Myriophyllum spicatum and Potamogeton perfoliatus). Those species which remove 5% or less of the available carbon are taken to be unable or poorly able to use HCO3(-). Such macrophytes may benefit from: growing in unproductive lakes that do not experience carbon depletion; seasonal access to aerial CO2; high CO2* concentrations in and close to the sediment. Competition for inorganic carbon may be an important factor determining the outcome of seasonal and longer-term changes in the species composition of productive freshwaters. The reduction or loss of submerged macrophytes in certain recently enriched lakes may result partly from carbon competition with phytoplankton. (Author's abstract)
W84-02399

SEDIMENTOLOGY AND GEOCHEMISTRY OF RECENT SEDIMENTS OFF THE MOUTH OF THE NIAGARA RIVER, LAKE ONTARIO,
Canada Centre for Inland Waters, Burlington, Ontario.
P. G. Sly.
Journal of Great Lakes Research, Vol. 9, No. 2, p 134-159, 1983. 19 Fig, 6 Tab, 39 Ref.

Descriptors: *Lake Ontario, *Niagara River, *Lake sediments, Geochemistry, Bathimetry, Trace elements, Particle size, Niagara Bar, Cadmium, Chromium, Copper, Lead, Zinc, Mercury, Dispersal patterns, Suspended load.

Sediment thickness and bathymetric characteristics were derived from echo sounding, side scan sonar, and shallow seismic reflection recordings. Sediment samples were analyzed for particle size, major and trace elements, and for benthic organisms. The Niagara Bar has been separated into Inner and Outer Bar deposits and it is proposed that the Outer Bar was formed during an earlier, lower stage of Lake Ontario. Both deposits appear to be largely derived from reworked, local, shoreline materials. Trace element analyses indicate that the surficial sediments (prior to the 1972 Great Lakes Water Quality Agreement) were moderately enriched in Cd, Cr, Cu, Pb, and Zn, and greatly enriched in Hg. Normalized distributions of trace elements in the bar sediments show the presence of distinct dispersal patterns. These dispersals indicate that some of the suspended load passes out of the main outflow channel, across the bar, and toward west and north northwest directions. Particle-size and geochemical characteristics of the off-shore sediments indicate that they differ significantly from marginal facies and imply that local variations in the forms and type of peripheral inputs to the lake have little influence on deep basin deposits. (Author's abstract)
W84-02405

NEPHELOID LAYER IN LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Aquatic Ecology Div.
R. G. Sandilands, and A. Mudroch.
Journal of Great Lakes Research, Vol. 9, No. 2, p 190-200, 1983. 13 Fig, 5 Tab, 21 Ref.

Descriptors: *Lake Ontario, *Nepheloid layer, *Transmissivity, Turbidity, Suspended sediments, Diatoms, Quartz, Calcite, Clay, Particulate matter, Soluble reactive phosphorus, Reactive silica, Lead, Zinc.

A study was designed to investigate the existence and extent of a nepheloid layer in Lake Ontario. A transmissometer profile of the entire water column was obtained monthly from 94 stations in Lake Ontario during the period of August to December, 1981. The profiles indicated that a turbid layer at the lake bottom existed over the entire lake at water depths greater than 60 m. The thickness of the layer averaged 22 m in August and September, but doubled to 45 m in October. In addition, the average transmission was lowered from 60% in August and September to 45% in October. A significant increase in soluble reactive phosphorus (SRP) and reactive silica (RSiO2) in the nepheloid layer was observed. Quartz and calcite were the major mineral constituents of the suspended matter present in the layer. The particles in the nepheloid layer in the western basin of Lake Ontario consisted of many diatoms and some calcite particles and clay minerals. In the central and eastern basins the number of calcite particles significantly increased. Concentrations of Pb and Zn in the suspended matter sampled from the nepheloid layer at the Niagara River mouth were similar to those found in the 1-cm surface sediment at the same station (124 micro g/g Pb, 318 micro g/g Zn, and 139 micro g/g Pb and 356 micro g/g Zn, respectively). (Author's abstract)
W84-02409

DOWNFLUX OF SEDIMENT, ORGANIC MATTER, AND PHOSPHORUS IN THE NIAGARA RIVER AREA OF LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Aquatic Ecology Div.
M. N. Charlton.
Journal of Great Lakes Research, Vol. 9, No. 2, p 201-211, 1983. 11 Fig, 2 Tab, 15 Ref.

Descriptors: *Lake Ontario, *Nepheloid layer, *Niagara River, Sediments, Organic matter, Phosphorus, Water circulation, Suspended sediments, Sedimentation, Downflux.

Vertical arrays of sediment traps were installed near the mouth of the Niagara River and at nearshore and offshore sites. Surveys of temperature, turbidity, and conductivity were used to establish that the traps nearest the river mouth were under the river outflow plume. A single offshore array in 1980 indicated downfluxes of 1-2 g/sq m/d of dry matter in the mid-water column. These fluxes were similar to those of small lakes but much higher fluxes were found near the bottom of Lake Ontario. More extensive work in 1981 confirmed the presence of a near-bottom nepheloid layer and the effect it has on the increasing downflux estimates. Sediment traps near shore and at the river mouth caught substantially more material at all depths than did traps at the offshore stations. Downfluxes of phosphorus and sediment were consistent with independent estimates of loading and retention. (Author's abstract)
W84-02410

STATISTICAL EVALUATION OF TRENDS IN THE WATER QUALITY OF THE NIAGARA RIVER,
National Water Research Inst., Burlington, Ontario. Aquatic Physics and Systems Div.
For primary bibliographic entry see Field 5B.
W84-02412

NUTRIENT REGENERATION BY ZOOPLANKTON IN SOUTHERN LAKE HURON,
Michigan Univ., Ann Arbor. Div. of Biological Sciences.
J. Korstad.
Journal of Great Lakes Research, Vol. 9, No. 3, p 374-388, 1983. 6 Fig, 6 Tab, 55 Ref.

Descriptors: *Zooplankton, *Lake Huron, *Cycling nutrients, Nutrient regeneration, Phosphorus, Ammonia, Nitrates, Nitrites, Silica, Diel distribution, Plankton.

Rates of nutrient regeneration by zooplankton (micro mol/mg dry wt/hr) in southern Lake Huron from April to August 1975 ranged from undetectable to 2.6 for total phosphous (TP), undetectable to 0.8 for total soluble phosphorus (TSP), undetectable to 0.12 for soluble reactive phosphorus (SRP), undetectable to 0.97 for ammonia (NC3) undetectable to 3.8 for nitrate plus nitrite (NO3 + NO2), and undetectable to 2.9 for silica (SiO2). Two diel experiments were conducted. Times of highest rates of regeneration varied for the different nutrients on these dates. Using the average concentration of zooplankton in the surface waters during this study, the calculated average concentration of nutrients regenerated by zooplankton ws 0.012 micro mol P/L/hr for TP, 0.0046 micro mol P/L/hr for TSP, 0.0016 micro mol P/L/hr for SRP, 0.0146 micro mol N/L/hr for NH3, 0.043 micro mol N/L/hr for NO3 + NO2 and 0.058 micro mol Si/L/hr for SiO2. The contribution of nutrient regeneration by zooplankton to the turnover time of the various nutrients in the surface waters was calculated to be 212 hr for TP, 239 hr for TSP, 69 hr for SRP, 62 hr for NH3, 505 hr for NO3 + NO2 and 531 hr for SiO2. Although the turnover time for most of these nutrients is fairly slow, the nutrient pools for SRP and NH3 are replenished in less than 70 hr by nutrient regeneration. Zooplankton therefore appear to play a significant role in the cycling of SRP and NH3 in southern Lake Huron. (Moore-IVI)
W84-02424

ADDITIONS OF NUTRIENTS AND MAJOR IONS BY THE ATMOSPHERE AND TRIBUTARIES TO NEARSHORE WATERS OF NORTHWESTERN LAKE HURON,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
B. A. Manny, and R. W. Owens.
Journal of Great Lakes Research, Vol. 9, No. 3, p 403-420, 1983. 16 Fig, 7 Tab, 41 Ref.

Descriptors: *Nutrients, *Lake Huron, *Atmospheric fallout, *Tributaries, Nitrogen, Phosphorus, Ditching, Clear-cutting, Watersheds, Silica, Sodium.

Nutrient additions by the atmosphere and six tributaries to nearshore waters of northwestern Lake Huron were measured at weekly intervals from August 1975 to July 1976. The atmosphere contributed 43% of the nitrogen (N) and 10% of the phosphorus (P) that was added during the year. The 1975-76 atmospheric loading rate of total N to this area (11 kg/ha/yr) was one of the highest found to date in the United States. N was conserved more efficiently than P in the tributary drainage basins. Of the N and P that fell annually on the watersheds under study, 2 to 37% of the N and 31 to 84% of the P was carried with runoff to the lake. From a basin where ditching and clear-cutting occurred, water, P, silica (SiO2), N, and sodium were lost at higher rates than from five other basins. Most of the N in bulk atmospheric samples (23%) and tributary waters (56%) was dissolved organic N, a form of N not often measured. (Author's abstract)
W84-02425

SPRING PH AND ALKALINITY DEPRESSIONS IN LAKE SUPERIOR TRIBUTARIES,
Ontario Ministry of the Environment, Sudbury.
W. Keller.
Journal of Great Lakes Research, Vol. 9, No. 2, p 425-429, 1983. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Alkalinity, *Hydrogen ion concentration, *Seasonal variation, *Ontario, *Tributaries, *Lake Superior, Speckled Trout Creek, Barrett River, Buffering capacity, High flow, Fisheries.

Between October 1980 and October 1981, the pH and alkalinity of 21 Lake Superior tributaries in Ontario were measured. All tributaries, even those with high buffering capacity during most sampling periods, showed substantial reductions in pH and alkalinity during spring runoff. Recorded minima for these parameters were associated with high spring flows while maxima were associated with

low flow periods, primarily in late summer. In most tributaries the degree of pH depression observed was not extreme; however, Speckled Trout Creek and the Barrett River exhibited low minimum pH (5.09 and 5.00, respectively) and an additional five showed pH minima in the range of 5.5 to 6.0. Although adverse effects on fish populations in the study area have not been documented, concern over possible influences is warranted because these waters exhibit generally high sensitivity to acidic inputs and most constitute valuable fishery resources. (Moore-IVI)
W84-02427

CONE-SHAPED HYPOLIMNION AND LOCAL REACTOR AS OUTSTANDING FEATURES IN EUTROPHICATION OF LAKE MARACAIBO,
Estudios y Controles en Contaminacion, Caracas (Venezuela).
For primary bibliographic entry see Field 5C.
W84-02428

ESTIMATING LARVAL FISH ABUNDANCES FROM PLANKTON NET CATCHES IN LONG POINT BAY, LAKE ERIE, IN 1971-78,
Ontario Ministry of Natural Resources, Port Dover.
J. M. Hamley, T. P. Howley, and A. L. Punhani.
Journal of Great Lakes Research , Vol. 9, No. 4, p 452-467, 1983. 6 Fig, 7 Tab, 34 Ref.

Descriptors: *Larval growth stages, *Fish populations, *Long Point Bay, *Lake Erie, Ontario, Nanticoke, Smelt, Cyprinids, Environmental effects, Sampling, Industrial development.

Larval fish were sampled in Long Point Bay (Ontario) each summer in 1971-78 by towing 1/2-m and 1-m diameter plankton nets at about 1 m/s. The analysis of 2,576 tows gives detailed consideration to sampling problems and statistical methods. The most common larvae were rainbow smelt (Osmerus mordax), caught in about 50% of the tows and yellow perch (Perca flavescens), clupeids, and cyprinids, caught in about 10 to 20% of the tows. Most of the data contained too high proportions of zero catches to be transformed to approximately normal distribution, and were therefore analyzed using the low linear model rather than by analysis of variance. Except for cyprinids, larval fish seemed to be scarce in surface waters during the day. Small (4 to 10 mm long) smelt and perch larvae were caught more frequently in 526- than in 782-micro m mesh nets. Very few perch and cyprinid larvae longer than 10 mm were ever caught. This, and a more rapid decline of daytime than nighttime catches of larval smelt through the midsummer, suggests that the nets were avoided by at least the larger larvae. If avoidance of sampling gear is substantial, larval fish abundances may be overestimated in years of slow growth when the larvae remain catchable longer. There was no evidence that the recent industrial development at Nanticoke, Ontario, has affected larval fish abundances so far, but industrial stresses were low during this period. Natural fluctuations of average yearly catches are so large that only large changes can be detected even after several years of occurrence. (Moore-IVI)
W84-02429

DISTRIBUTION OF DIATOMS IN LAKE SUPERIOR SEDIMENTS,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 2J.
W84-02432

DISTRIBUTION OF LARVAL YELLOW PERCH (PERCA FLAVESCENS) IN NEARSHORE WATERS OF SOUTHEASTERN LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. Perrone, Jr., P. J. Schneeberger, and D. J. Jude.
Journal of Great Lakes Research, Vol. 9, No. 4, p 517-522, 1983. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Distribution, *Lake Michigan, *Perch, *Larvae, Nearshore processes, Fish management, Power plants, Fish populations, Lakes, Great Lakes, Spatial distribution, Temporal distribution.

Spatial and temporal distribution of larval yellow perch in southeastern Lake Michigan was described. Samples were collected during 1973-1981 with plankton nets and benthic sleds in water from 0.5 to 21 m deep. From mid-May to early or mid-July yellow perch larvae of less than 7.5 mm total length were numerous. Larvae taken before mid-June hatched from eggs spawned in inland waters, as opposed to Lake Michigan. Larvae appearing early occurred largely in shallow water, less than 1.5 meters in depth. Larvae caught later were mainly distributed in deeper water, greater than 6 meters. Larval perch abundance was similar at all bottom depths greater than 6 meters, was low in surface water during the day and low near bottom at night. Significantly more larvae were caught at night than during the day at 0.5 and 1.5 meter stations. This work was part of investigations of fish populations near the J. H. Campbell Power plant near Grand Haven, Michigan, and the D. C. Cook Nuclear Power Plant near Brigman, Michigan. (Baker-IVI)
W84-02433

NEARSHORE PHYTOPLANKTON OF HAMMOND BAY, LAKE HURON,
National Marine Fisheries Service, Ann Arbor, MI. Great Lakes Fishery Lab.
C. L. Brown, and B. A. Manny.
Journal of Great Lakes Research, Vol. 9, No. 4, p 523-529, 1983. 5 Fig, 2 Tab, 25 Ref.

Descriptors: *Nearshore processes, *Phytoplankton, *Lake Huron, *Hammond Bay, Bays, Population dynamics, Diatoms, Chrysophyta, Eutrophication, Algae, Great Lakes, Nutrients, Seasonal variation.

Phytoplankton were collected from a small, nearshore water intake at Hammond Bay four times per week from August 1973 to July 1975. The samples were used to predict the effects of increased nutrient loading on nearshore phytoplankton populations in northern Lake Huron. Phytoplankton density, taxonomic composition, and biomass in the nearshore waters followed predictable, seasonal fluctuations during each of two 12-month period. In June the density of total phytoplankton was high at 450-600 cells/mL. From January to April each year the density was low, from 60 to 210 cells/mL. The mean annual composition of the phytoplankton assemblage by number was 33% cryptomonads, 24% diatoms, 16% chrysophytes, 16% blue-green algae, and 10% green algae. Phytoplankton biomass was low through each year in the range from 0.09 to 0.66 g/cu m, resembling values which had been previously reported for Lake Superior. Pennate diatoms contributed 60-80% of the total biomass from December to April and in July. Phytoflagellates consisting of chrysophytes and cryptomonads accounted for 35% of the biomass during the entire study period. (Baker-IVI)
W84-02434

ABUNDANCE AND BIOMASS OF THE MEIOBENTHOS IN NEARSHORE LAKE MICHIGAN WITH COMPARISONS TO THE MACROBENTHOS,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
T. F. Nalepa, and M. A. Quigley.
Journal of Great Lakes Research, Vol. 9, No. 4, p 530-547, 1983. 5 Fig, 8 Tab, 53 Ref.

Descriptors: *Biomass, *Nearshore processes, *Lake Michigan, *Benthos, Great Lakes, Macrobenthos, Nematodes, Aquatic animals, Detritus, Decomposing organic matter, Meiobenthos.

Cores were taken from 11, 17, and 23 meters at monthly intervals from May to November of 1976-79 in order to quantify the meiobenthos of nearshore southeastern Lake Michigan. The total meiobenthic abundance ranged from 69,700/ sq m to 1,300,000/sq m and total biomass ranged from 0.03 to 0.87 g/sq m. Nematodes accounted for 80% of all individuals and 66% of the biomass. In late spring to summer most of the major groups peaked in population density. However, some peaked in early spring and fall. Mean annual densities varied from two-fold to 12-fold at a given station with the exceptions of nematodes. More abundant life was noted for harpacticoids, tardigrades, and ostracods living at the deeper depths. Cyclopoids and cladocerans were less abundant at greater depths. No consistent relationship was found between sampling depth and the abundance of nematodes and rotifers. In many of the groups temporal and spatial variation appeared to be related to changes in the amount of bottom detritus. The overall macrobenthos:meiobenthos biomass ratio was 15:1 and ranged from 5:1 to 45:1 on an annual basis. (Baker-IVI)
W84-02435

VARIATIONS IN THE DISTRIBUTION OF SUSPENDED PARTICLES DURING AN UPWELLING EVENT IN LAKE MICHIGAN IN 1980,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
G. L. Bell, and B. J. Eadie.
Journal of Great Lakes Research, Vol. 9, No. 4, p 559-567, 1983. 4 Fig, 18 Ref.

Descriptors: *Upwelling, *Suspended sediments, *Lake Michigan, Great Lakes, Distribution, Sediments, Temperature effects, Transparency, Sediment transport, Thermal stratification, Path of pollutants.

The hypothesis that suspended fine-grained particles moving downslope within the nepheloid layer in Lake Michigan are periodically reintroduced into the nearshore and euphotic zones during upwelling events was tested. Upwelling currents did redistribute suspended materials within the nepheloid layer and also reintroduced these materials into the nearshore and epilimnion. Upslope transport and redistribution of these materials are indicated by the distribution patterns of temperature, transparency and total suspended materials. The suspended materials were apparently being mixed into the overlying water in the nearshore region and then deflected lakeward over the top of the encroaching water mass. Most of the return flow was above the thermocline. The distribution of temperature, transparency, and specific conductance all indicated a westward flow above the thermocline. The same turbidity patterns will not likely develop with each upwelling event, but will vary depending on the velocity, direction, and proximity to the bottom of the upwelling currents; the timing with respect to the maximum upwelling; the variations in the available suspended materials; and the degree of thermal stratification. Resuspension and the reintroduction of fine grained particulates into the euphotic zone through upwelling events can play a large role in the long term behavior and fate of persistent contaminants such as PCB. (Baker-IVI)
W84-02437

RELATIONSHIPS AMONG ZOOBENTHOS, SEDIMENTS, AND ORGANIC MATTER IN LITTORAL ZONES OF WESTERN LAKE ERIE AND SAGINAW BAY,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
R. A. Cole, and D. L. Weigmann.
Journal of Great Lakes Research, Vol. 9, No. 4, p 568-581, 1983. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Littoral zones, *Benthic environment, *Saginaw Bay, *Lake Erie, *Benthos, Great Lakes, *Sediments, Zoobenthos, Organic matter, Eutrophication, Tubificids, Chironomids, Macrophytes.

Samples were taken of zoobenthos and sediments from the littoral zones in western Lake Erie and Saginaw Bay. Mostly infaunal species of Tubifici-

dae and Chironomidae inhabited the littoral zones. A very significant correlation was noted between the abundance and mean size of zoobenthic groups and the particle size and organic content of sediments. The weight and mean size of zoobenthos were greatest in organically rich silts and clays and least in organically poor sands. The proximity of fine grained sediments greatly influenced the relative abundance and mean size of zoobenthos in sands. Sandy sediments next to muddy sediments had zoobenthic groups with weights and mean size similar to those in adjacent muddy sediments. Low to moderate densities of submerged macrophytes on muddy sediments had a small, non-significant impact on zoobenthic abundance and composition compared to similar sediments without macrophytes. In well mixed littoral zones with sediments of diameters less than 1.5 mm, particle size and organic matter in sediment may serve as a reliable index to standing stocks of zoobenthos. (Baker-IVI)
W84-02438

FOOD SELECTION OF THE CILIATED PROTOZOA, CONDYLOSTOMA VORTICELLA (EHRENBERG) IN LAKE KASUMIGAURA,
National Inst. for Environmental Studies, Tsukuba (Japan). Environmental Biology Div.
N. Takamura, and M. Yasuno.
Japanese Journal of Limnology, Vol. 44, No. 3, p 184-189, July, 1983. 2 Fig, 1 Tab, 20 Ref.

Descriptors: *Protozoa, *Lake Kasumigaura, *Japan, *Food, Aquatic animals, Algae, Eutrophication.

The food selection of a herbivorous ciliated protozoa, Condylostoma vorticella (Ehrenberg) was examined in November of 1980 using Ivlev's electivity index. This ciliated protozoa selectively fed on Synechococcus, Kirchneriella, Dictyosphaerium, Coscinodiscus, Cryptomonas, Chlamydomonas, and Gomphosphaeria, but rejected Closterium, Phormidium, Synedra, Tegrastrum, Dactylococcopsis, Scenedesmus, Aphanizomenon, Melosira, and Micractinium. The size and shape of algae were significant in the food selection process, but the taxonomical groups were insignificant. The ciliate fed efficiently on food particles between 15 micrometers and 40 micrometers in size, but not filamentous and spindlelike algae or algae with long spines. Colonies of Microcystis found most abundantly in this lake were preferably ingested by the ciliate. This ciliated protozoa is likely a significant link in the food chain between Microcystis and crustacean zooplankton. (Author's abstract)
W84-02479

2I. Water In Plants

TISSUE WATER RELATIONSHIPS OF CALLITRIS COLUMELLARIS, EUCALYPTUS MELLIODORA AND EUCALYPTUS MICROCARPA INVESTIGATED USING THE PRESSURE-VOLUME TECHNIQUE,
Melbourne Univ., Parkville (Australia). Dept. of Botany.
K. A. Clayton-Green.
Oecologia, Vol. 57, No. 3, p 368-373, 1983. 2 Fig, 3 Tab, 21 Ref.

Descriptors: *Drought resistance, *Plant water potential, *Callitris, *Eucalyptus, Osmotic potential, Turgor, Plant water content, Drought hardening, Australia.

Callitris columellaris is a tree of inland Australia typically occurring in areas of 450-650 mm average annual rainfall, where droughts are common. In south-eastern Australia a mixed association with E. microcarpa and E. melliodora is common. Field studies have revealed differences in the drought resistance of these species. Using the pressure-bomb to construct pressure-volume curves, a cellular basis of differential drought resistance was found in C. columellaries, E. melliodora, and E. microcarpa. Among these three species differences were found in bound water, relative water content and water potential at zero turgor, osmotic potential at full turgor and bulk modulus of elasticity. These parameters showed C. columellaris to be the most, and E. melliodora the least drought resistant of the three species. C. columellaris may have a greater drought resistance, because at low water potentials its foliar tissue has a greater desiccation resistance. This desiccation resistance would be enhanced by the greater percentage of bound water in C. columellaris compared with the eucalypts. Drought hardening may involve an increase in bound water content, dry weight: turgid weight ratio and a decrease in osmotic potential at full turgor and water potential at zero turgor. (Moore-IVI)
W84-02254

MODELING OF THE OXYGEN REGIME OF A FRESHWATER BODY DURING SUMMER HEATING,
Moscow State Univ. (USSR).
V. V. Alekseev, Yu. I. Gorbatov, A. O. Kokorin, and M. Ya. Lyamin.
Water Resources, Vol. 9, No. 4, p 345-355, July-August, 1982. 5 Fig, 24 Ref. Translated from Vodnye Resursy, No. 4, p 15-26, July-August, 1982.

Descriptors: *Dissolved oxygen, *Temperature effects, *Lakes, Cyanophyta, Chlorella, Climates, Seasonal variations, Water circulation, Eutrophication, Water quality, Water pollution effects.

Prediction of water quality under anthropogenic loads on a water body has become a most important scientific problem. Oxygen is one of the determining indicators of water quality. A mathematical model of the dynamics of oxygen was constructed taking into account the photosynthetic process. The theoretical data agree well with the results of experiments conducted. An approach to a description of processes occurring in the water body was proposed and some numerical characteristics were given. The need for a detailed examination of the carbonate cycle in water was shown. The model does not describe blooms caused by blue-green algae. According to the model, under any conditions Chlorella without mixing sinks to the lower layers of the water body, where the amount of light is insufficient for intense photosynthesis, and eventually dies. Upward movement of Chlorella occurs only by diffusion and is very little. The characteristic time of diffusion is almost two orders greater than the characteristic time of settling of the Chlorella particles. (Baker-IVI)
W84-02318

2J. Erosion and Sedimentation

CLAY MINERALOGY OF SEDIMENTS IN THE VAAL DAM AND IN THE RIVERS SUPPLYING AND DRAINING THE DAM UPSTREAM OF THE BARRAGE,
Geological Survey, Bellville (South Africa). Marine Geosciences Unit.
G. F. Birch.
Water South Africa, Vol. 9, No. 3, p 117-123, July, 1983. 8 Fig, 2 Tab, 7 Ref.

Descriptors: *Clays, *Drainage basins, *South Africa, *Wilge River, *Vaal Dam, *Vaal River, Sediments, Minerals.

Clays in the sediments from the Vaal Dam and from the Vaal and Wilge Rivers are mainly illitic (about 81%), with smaller quantities of smectite (about 16%) and kaolinite (about 4%). Chloritic clays are absent. A distinctive clay mineral distribution pattern can be related to the geology of the drainage basin. The drainage area is underlain by rocks predominantly of the Karoo Supergroup which, when eroded, liberate mainly illitic clay minerals. The breakdown of volcanic and feldspathic rocks of the Ventersdorp and Witwatersrand Supergroups in the north western part of the basin produce expandable smectitic clay minerals and kaolinite, respectively. The Vaal Dam and Vaal River downstream of the latter areas contain sediments which are enriched in smectite and kaolinite. Sediments in the lower reaches of the submerged Wilge River tributary are also enriched in kaolinite and smectite, probably due to mixing and diffusion of Vaal River water which is rich in these minerals. Although some of the rocks of the drainage basin contain chloritic clays, this mineral is not present in young sediments of the region, probably because it is unstable in the present-day environment. Vertical trends in the clay mineral abundance may represent an incomplete sedimentation cycle governed by differential settling rates of clay minerals. (Author's abstract)
W84-02312

DISTRIBUTION OF DIATOMS IN LAKE SUPERIOR SEDIMENTS,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
V. L. Thayer, T. C. Johnson, and H. J. Schrader.
Journal of Great Lakes Research, Vol. 9, No. 4, p 497-507, 1983. 8 Fig, 1 Tab, 33 Ref. NSF grants OCE 78-08166 and OCE-8018339.

Descriptors: *Lake sediments, *Diatoms, *Distribution, *Lake Superior, Phytoplankton, Sedimentation rates, Bathymetry, Great Lakes.

Diatom frustules do not rain down uniformly onto the bottom of Lake Superior but are preferentially deposited in nearshore bathymetric depressions and some marginal bays. Regions containing relatively high diatom concentrations in the upper 50 cm of sediment include Thunder Bay, Thunder Bay trough, Keweenaw Bay, and the northshore trough. There is a paucity of diatom frustules throughout the upper 50 cm of open-lake sediments. Only a weak correlation was found between diatom concentrations in surface sediment and diatom biomass in the overlying waters. Diatom abundance was a function of bathymetry and distance from shore in the western half of Lake Superior, including Keweenaw Bay. The relationship between diatom abundance and water depth/offshore distance was not clearly defined in the valley and ridge region of southeastern Lake Superior. Diatom abundance increased with increasing sedimentation rate and proximity to the shore at the 10- and 20-cm horizons in the sediments. Diatoms were abundant in the surface sediment of areas with either low or high sedimentation rates. Fossil diatom concentrations in the western arm of Lake Superior were diluted by a high input rate of terrigenous sediment from the eroding Wisconsin shoreline. (Baker-IVI)
W84-02432

SEDIMENT DELIVERY PROBLEM,
Exeter Univ. (England). Dept. of Geography.
D. E. Walling.
Journal of Hydrology, Vol. 65, No. 1-3, p 209-237, August, 1983. 13 Fig, 7 Tab, 87 Ref.

Descriptors: *Sediment transport, *Model studies, Erosion, Sedimentation, Channels, Spatial distribution, Nutrients, Drainage basin, Soil erosion.

The limitations of the sediment delivery ratio concept are reviewed by considering the problems of temporal and spatial lumping and its blackbox nature. Recent advances in the understanding of the sediment delivery system and its modelling are described and the lack of detailed empirical investigations is highlighted. The significance of recent concern for the role of sediments in the transport of nutrients and contaminants to sediment delivery studies is introduced. Appreciation of the wider enviromental significance of erosion and sediment delivery processes in the context of material transfer through terrestrial and aquatic ecosystems provides a further need for improved understanding of sediment delivery processes. The lack of empirical studies of the processes, pathways, sinks and time constants involved in the delivery process must hamper progress. Recent advances in distributive modelling of erosion and sediment yield clearly represent a significant advance. (Baker-IVI)
W84-02447

DISTRIBUTION FUNCTION APPROACH TO MODELLING BASIN SEDIMENT YIELD,
Institute of Hydrology, Wallingford (England).
R. J. Moore, and R. T. Clarke.

Journal of Hydrology, Vol. 65, No. 1-3, p 239-257, August, 1983. 8 Fig, 21 Ref.

Descriptors: *Sediment transport, *Model studies, *Sediment yield, Mathematical studies, Hydrographs, Erosion, Storm runoff.

The distribution function theory provides both a plausible description of sediment removal and translation as supply- and transport-limited processes, and a model structure suitable for automatic parameter optimization by gradient-based procedures. The exhaustion of sediment supplies during a storm event and the increasing availability of sediment as the inter-storm period lengthens are able to be represented by the mathematical description of accumulation of sediment and its removal by direct runoff. A linear convolution integral operation is used to accomplish translation of water and sediment to the basin outlet. An inverse Gaussian probability density function is proposed as a suitable two-parameter form for the instantaneous unit hydrograph. The relation of this distribution to the convection-diffusion equation, and its extension to represent settling out of sediment from suspension, are discussed. An extension of the distribution function model to incorporate a drainage (or baseflow) component is introduced as one means of representing hydrographs with protracted recessions. (Baker-IVI)
W84-02448

EVALUATION OF BED TRANSPORT AND RESISTANCE EQUATIONS IN FLUVIAL HYDRAULICS,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
N. A. Zaghloul.
Journal of Hydrology, Vol. 66, No. 1-4, p 269-290, October, 1983. 14 Fig, 1 Tab, 13 Ref.

Descriptors: *Sediment transport, *Fluvial sediments, *Resistance, Bed load, Sedimentation, Alluvial deposits, Hydraulics, Sediment deposition, Scour.

Because of the complexity and random nature of the problem of deposition and scour, the approaches of study are empirical or semi-empirical. Bed-load formulas give results which may differ by 100% or more. An extensive experimental investigation, inducing sedimentation and scour under various conditions, was conducted. The data analysis was utilized to examine the relative validity of the most popular bed-load formulas as well as those pertaining to flow resistance due to bed forms. A procedure involving a combination of the bed-load formulas and the appropriate resistance equation was devised to determine the sediment discharge. The procedure is intended for practical application. Among the popular bed-load formulas, Kalinske's equation gave the best correlation with the experimentally determined sediment discharge. The values of the energy slope, calculated by the resistance equations, are in reasonable conformity with the experimental values. A relatively better agreement was found for the starvation case than for sedimentation. In case of sedimentation the Chezy-Simons and Richardson approach gave the best agreement and the Liu-Hwang's approach was superior in case of scour. The procedure which combines the bed-load formulas and resistance equations produced reliable results for the conditions tested and, therefore, is recommended for practical application under the same conditions. (Baker-IVI)
W84-02471

2K. Chemical Processes

TRACING THE SOURCES OF THE CHEMICAL COMPOSITION OF PRECIPITATION BY CLUSTER ANALYSIS,
Netherlands Energy Research Foundation ECN, Petten.
J. Slanina, J. H. Baard, W. L. Zijp, and W. A. H. Asman.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 41-45, July 1983. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Chemistry of precipitation, *Cluster analysis, Hydrogen ion concentration, Air pollution, Netherlands.

Cluster analysis was applied to a precipitation chemistry data base obtained by sampling by means of 8 wet-only samplers on one location in the northwestern part of the Netherlands for sampling periods of 2 and 3 days. Two main groups were found, corresponding to either continental or maritime origin, which coincided with prior meteorological analysis. Each main group consisted of two subgroups. Polluted maritime air seems to be an important source of H(+), presumably due to the low NH3 concentration in maritime air and hence little neutralization of strong acids. (Author's abstract)
W84-02125

COMPARATIVE STUDY ON THE ELEMENTARY COMPOSITION OF FULVIC AND HUMIC ACIDS OF AQUATIC ORIGIN AND FROM SOILS AND MICROBIAL SUBSTRATES,
Laval Univ., Quebec. Dept. of Soil Sicence.
S. A. Visser.
Water Research, Vol. 17, No. 10, p 1393-1396, 1983. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Decomposing organic matter, *Water chemistry, Humic acids, Fulvic acids, Chemical composition, Soil chemistry, Laurentide Provincial Park, Quebec.

The elementary composition of molecular fractions of fulvic and humic acids sampled regularly during a 5 months period was investigated. The samples were taken at various locations in a watershed within the Laurentide Provincial Park, in Quebec. The investigation also included humic material produced by a streptomycete culture and sampled at regular intervals during a 6 months incubation period in order to study the effect of humification on the elementary composition. The aquatic humus had lower carbon and nitrogen and higher oxygen contents than humic compounds isolated from soils. Its fulvic and humic acids appeared to have more characteristics in common than is normally the case for terrestrial humus. During the course of the summer season it gradually became richer in carbon and poorer in oxygen. At least for recently formed material, fulvic acids became more oxidized with the process of progressive humification. Higher molecular weight fractions of the aquatic humic matter were also richer in oxygen than lower molecular weight material. (Baker-IVI)
W84-02189

IDENTIFICATION OF RUNOFF SOURCES OF A FORESTED LOWLAND CATCHMENT; A CHEMICAL AND STATISTICAL APPROACH,
Amsterdam Univ. (Netherlands). Lab. for Physical Geography and Soil Science.
J. J. H. M. Duysings, J. M. Verstraten, and L. Bruynzeel.
Journal of Hydrology, Vol. 64, No. 1/4, p 357-375, July, 1983. 4 Fig, 7 Tab, 34 Ref.

Descriptors: *Forest watersheds, *Precipitation, Seasonal variations, Rainfall, Statistical analysis, Storm runoff, Snowmelt, Hydrology, Catchment areas, Water chemistry.

The seasonal and intra-storm variations in streamwater chemistry are described and used to distinguish runoff and solute sources in the catchment. Sources of solutes include those contained in water from: throughfall falling on the river channel and adjacent partial areas; litter-layer water and water from the organic-rich sandy topsoil (Al horizon); or throughflow in the sandy layer (A2 horizon). Statistical treatment of the streamwater concentration data by means of factor and cluster analysis show the significant relationships and different behavior of three groups of solute species: K, NH4, NO3/Mg, Na, Cl/Ca, Si, SO4, each group having a different response to rainfall. The first group, K, NH4, and NO3 shows an increasing concentration during the first part of a storm and a decrease afterward. The second, Na, Cl, and Mg shows a lowered concentration during the first part of a storm with increases after the discharge peak is reached. The third, Ca, Si, and SO4, group shows dilution on the rising limb and enrichment on the falling limb of the hydrograph. In winter and spring, however, Si and SO4 show an earlier increase in concentration in contrast to Ca. Three types of storm events with specific hydrologic situations could be distinguished: winter and spring storms generating direct runoff and baseflow; summer and autumn storms generating only direct runoff; and snowmelt runoff. Each of these types of runoff event is charactertized by a particular solute behavior, related to contributions from the different runoff and solute sources. The validity of this model of solute contributions by these sources (throughfall (stemflow), litter and soil waters) is corroborated by the measured concentration levels of these sources. (Baker-IVI)
W84-02215

OFF-FLAVOURS IN AQUATIC ECOSYSTEMS - AN INTRODUCTION,
Helsinki Univ. (Finland). Dept. of Limnology.
For primary bibliographic entry see Field 5F.
W84-02267

ODOUR PROBLEMS IN TWO RESERVOIRS,
Water Research Inst., Prague (Czechoslovakia).
For primary bibliographic entry see Field 5F.
W84-02269

STUDY OF THE SULFUR ISOTOPIC COMPOSITION OF GROUNDWATERS FOR SOLVING HYDROGEOLOGICAL PROBLEMS (WITH SPECIAL REFERENCE TO THE CHU-SARYSU ARTESIAN BASIN),
For primary bibliographic entry see Field 2F.
W84-02332

SORPTION ABILITY OF PEAT SOILS AND THEIR ROLE IN THE FORMATION OF THE COMPOSITION OF SOIL AND GROUNDWATERS,
Moscow State Univ. (USSR).
D. S. Orlov, and I. I. Lytkin.
Water Resources, Vol. 10, No. 1, p 41-52, January-February, 1983. 4 Fig, 5 Tab, 19 Ref. Translated from Vodnye Resursy, No. 1, p 81-93, January-February, 1983.

Descriptors: *Peat soils, *Water analysis, *Groundwater, Sorption, Minerals, Sulfides, Phosphates, Carbonates, Calcium, Peat bogs, Organic matter.

Peat bogs play a specific and considerable role in the formation of the composition of subsurface waters. They are distinguished by a high sorption ability, enrich water in organic matter, promote the development of reducing processes influencing the mobility of a number of elements, and are zones of accumulation of sulfides, carbonates, and phosphates. Data are listed concerning the physical and chemical properties of peat soils and the chemical composition of the soil and groundwaters of peat soils. The adsorption of cations and anions by peat soils under dynamic connditions from 0.05 N KCl and Ca(NO3)2 is tabulated. Peat soils and peat bogs play a dual role in the formation of the composition of certain natural waters. On the one hand they are powerful natural geochemical barriers on the path of migration of chemical substances and especially substances of a technogenic origin. On the other hand peat bogs supply the environment with a large amount of mineral and organic compounds with the soil and groundwaters. Waters of lowmoor peat bogs remove mainly mineral components, whereas waters of highmoor peat bogs remove a greater amount of organic matter. (Baker-IVI)
W84-02345

CHEMICAL COMPOSITION OF NATURAL WATERS AND ROCK WEATHERING IN THE IZU PENINSULA AREA AS AN INDEX TO EARTHQUAKE-CAUSED LANDSLIDES,
Miyasaki Univ. (Japan). Dept. of Civil Engineering.

For primary bibliographic entry see Field 8E.
W84-02477

ROCK WEATHERING ESTIMATED BY DISSOLVED CHEMICAL CONSTITUENTS IN LAND WATER; MARL AREA OF OKINAWA ISLAND,
Okinawa Inst. of Physicachemical Res., Okinawa City.
E. Tohyama.
Japanese Journal of Limnology, Vol. 44, No. 3, p 173-183, July, 1983. 5 Fig, 4 Tab, 19 Ref.

Descriptors: *Weathering, *Rocks, *Okinawa, Erosion, Chemical reactions, *Marl, Water analysis, Minerals, Water chemistry.

Shimajiri marl is a bluish-gray soft rock occurring widely in the southern part of Okinawa Island. Major minerals of soil derived from the marl include montmorillonite, kaolinite, illite and chlorite. Primary rock minerals found in marl are assumed to be feldspar, calcite, dolomite, gypsum, pyroxene, halite and so forth. Carbon dioxide containing waters in the marl area react with these primary minerals. Chemical constituents such as Ca, Mg, Na, K, HCO3, Cl, SO4 ions and soluble SiO2 are dissolved from the minerals into the natural waters with the eventual formation of clay minerals. An example of the chemical weathering of rock forming minerals is given. The amounts of weathered silicate minerals and clay minerals as well as primary minerals can be calculated from these chemical equations for weathering. For the Shimajiri marl area the calculations suggest the following: primary rock minerals weathered, 350 t/sq km/year; clay minerals formed, 120 t/sq km/year; and chemical species released, 340 t/sq km/year. (Baker-IVI)
W84-02478

2L. Estuaries

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: I. A CHARACTERIZATION,
Vermont Univ., Burlington. School of Natural Resources.
J. C. Clausen, and K. N. Brooks.
Water Resources Bulletin, Vol. 19, No. 5, p 763-767, October, 1983. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Peat bogs, *Fen, *Minesota, *Water quality, Runoff, Hydrogen ion concentration, Specific condustance, Alkalinity, Calcium, Magnesium, Ammonia, Acidity, Color, Aluminum, Humic acids, Fulvic acids, Vegetation, Chemical oxygen demand.

The likelihood of expanded use of Minnesota's 3 million hectares of peatlands prompted the state to initiate a hydrologic study to characterize these groundwater-linked systems. Determining the quality of streamflow from these peatlands was an integral part of the study. Peatlands could be differentiated either on the basis of streamflow quality or on soil-vegetation characteristics. The quality of streamflow from 45 undisturbed peatlands was characterized by collecting samples five times in 1979-1980 and analyzing them for 27 water quality characteristics. Runoff pH, specific conductance, alkalinity, calcium, and magnesium were used to classify the peatlands as bog, transition, or fen. Bog runoff was lower (alpha = 0.05) in pH, calcium, sodium, manganese, and ammonia nitrogen than fen runoff, but was higher in acidity, color, aluminum, humic and fulvic acid, and chemical oxygen demand than fen runoff. Bogs had more fibric peat of a lower pH than fens; fens exhibited tall woody shrubs which were virtually absent on bogs. (Author's abstract)
W84-02164

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: II. A METHOD FOR ASSESSING MINING IMPACTS,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 5B.
W84-02165

SEASONAL CHANGES IN THE FORMS AND SPECIES OF IRON AND MANGANESE IN A SEASONALLY-INUNDATED FLOODPLAIN SWAMP,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
L. A. Smock, and E. J. Kuenzler.
Water Research, Vol. 17, No. 10, p 1287-1294, 1983. 5 Fig, 37 Ref. North Carolina Water Resources Research Institute Grant B-110-NC.

Descriptors: *Swamps, *Iron, *Manganese, *Seasonal variation, Particulates, Colloids, Floodplains, Flooding, Suspended solids, Soil chemistry.

The forms and species in which Fe and Mn occurred in a seasonally-inundated Southeastern United States floodplain swamp were examined. The analytical scheme provided operational estimates of the concentrations of Fe(II), Fe(III) and Mn in particulate (>0.45 micro m), colloidal (0.45-0.0032 micro m) and ultrafilterable (<0.0032 micro m) size fractions. The procedure also provided a differentiation between forms of Fe that were readily reactive to bathophenanthroline (BPN) and those forms that were unreactive to BPN until undergoing acid extraction. Further, the concentrations of Fe and Mn associated with suspended particulate matter in ion-exchangeable, reducible, and oxidizable forms and as inert mineral were determined using an operational classification scheme. The ferric species predominated due to the oxygenated conditions of the swamp water. Concentrations of colloidal-sized, readily-reducible Fe and of ultrafilterable Fe(II) and Fe(III) were low (<0.25 mg/l) and fairly constant throughout the study; more Fe occurred in the colloidal than ultrafilterable size range. The majority of the colloidal-sized Fe was in an acid-extracted form. Almost all ultrafilterable Fe was ferric, although high Fe(II) concentrations occurred in floodplain soil pore water. Total Fe, mainly particulate-associated, varied with periods of flooding and intense bioturbation. Manganese occurred in low concentrations, primarily in the ultrafilterable fraction, although colloidal-sized Mn forms were important at times. Most of the Fe and Mn associated with suspended particulates occurred in the inert mineral form and to a lesser extent in a reducible form. Ion-exchangeable and oxidizable particulate Fe and Mn were relatively unimportant. (Author's abstract)
W84-02181

STOCHASTIC SIMULATION MODEL OF BROWN SHRIMP (PENAEUS AZTECUS IVES) GROWTH, MOVEMENT, AND SURVIVAL IN GALVESTON BAY, TEXAS,
Texas A and M Univ., College Station. Dept. of Wildlife and Fisheries Sciences.
L. C. George, and W. E. Grant.
Ecological Modelling, Vol. 19, No. 1, p 41-70, May, 1983. 6 Fig, 3 Tab, 45 Ref.

Descriptors: *Shrimp, *Simulation, Galveston Bay, Texas, Mortality, Growth, Population dynamics, Water temperature, Fisheries, Sport fishing, Commercial fishing, Stochastic studies, Model studies.

A stochastic simulation model of brown shrimp (Penaeus aztecus Ives) population dynamics in Galveston Bay, Texas, is described, validated, and used to evaluate the effects of management alternatives and changing environmental conditions on shrimp dynamics. The model is composed of submodels representing: (1) recruitment, (2) growth, (3) natural mortality, (4) fishing mortality, and (5) emigration of brown shrimp. The model predicts significant changes in total annual harvest from the food shrimp, bait, and recreational fisheries resulting from (1) closure of the bay system to all fishing except during the spring and fall open seasons, (2) two-week postponement of the opening and closing of the open seasons for the food shrimp fishery, (3) a 2.5 C increase and (4) a 2.5 C decrease in mean water temperature, (5) an 80% increase and (6) and 80% decrease in fishing effort. No significant change in the total annual harvest is predicted when the food shrimp fishing season is extended from May 15 through December 15. Sensitivity analysis suggests that field experimentation designed specifically to test the hypothesis of a 60-day time lag between brown shrimp recruitment into the bays and exposure to the fishery should receive high priority. Simulation results are discussed within a management framework. (Author's abstract)
W84-02236

NITRIFICATION MODEL WITH AN INHIBITORY EFFECT OF SEA WATER,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
D. Akai, O. Miki, and S. Ohgaki.
Ecological Modelling, Vol. 19, No. 3, p 189-198, July, 1983. 8 Fig, 7 Ref.

Descriptors: *Estuarine environment, *Nitrification, *Seawater, Bacteria, Mathematical models, Noncompetitive inhibition, Effluent, Water pollution effects, Salinity.

A dynamic model of nitrification including bacterial growth equations was developed for the understanding of nitrification in estuaries. Sensitivity analysis based on the model revealed that not only maximum specific growth rates of nitrifiers but also yield constants and initial bacterial concentrations have great effect on the nitrification process. Batch experiments were carried out in order to investigate nitrification rates and an inhibitory effect on nitrification by sea water. The maximum specific growth rate of ammonia oxidizing bacteria in fresh water was estimated as 0.04 (/h) using a nonlinear regression method. The sea water content of 10%, 25%, 50% and 100% reduced the maximum specific growth rate of ammonia oxidizing bacteria to 0.027, 0.016, 0.0085 and 0.0028 (/h) respectively. The effect of sea water on nitrification was interpreted as noncompetitive inhibition. Bacteria of freshwater strains can be acclimated to a brackish environment for a long period of time. However, when secondary effluent is discharged into an estuary and bay, little acclimatization can be expected for bacteria in the effluent. Salinity exerts a significant influence on nitrification. (Moore-IVI)
W84-02241

SEASONAL VARIATIONS IN THE HEAT ENERGY BUDGET OF THE INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Foundation, Inc., Fort Pierce, Florida.
N. P. Smith.
Florida Scientist, Vol. 46, No. 3/4, p 168-178, 1983. 2 Fig, 1 Tab, 12 Ref.

Descriptors: *Heat budget, *Seasonal variation, *Indian River Lagoon, Florida, Water temperature, Heat storage, Solar radiation, Climate, Lagoons.

Meteorological records and water temperatures are used to describe annual variations in the heat budget of the Indian River lagoon, on the Atlantic coast of Florida. In the summer of 1979, water temperatures varied 1-2 C about the seasonal norm over time scales of about 1 wk. Heat stored in the lagoon was highly correlated with net isolation, net outgoing longwave radiation and sensible heat fluxes. In the winter of 1979-80, warming and cooling cycles varied temperatures + or - 3-4 C about the norm, and the storage term was significantly correlated with only the sensible and latent heat fluxes. (Author's abstract)
W84-02250

DIEL VARIATIONS OF DISSOLVED AMMONIA AND PHOSPHATE IN ESTUARINE SEDIMENT PORE WATER,
Harbor Branch Foundation, Inc., Ft. Pierce, Florida.
J. R. Montgomery, C. Zimmermann, G. Peterson, and M. Price.
Florida Scientist, Vol. 46, No. 3/4, p 407-414, 1983. 4 Fig, 1 Tab, 24 Ref.

Descriptors: *Estuarine environment, *Sediments, *Ammonium, *Phosphates, *Pore water, Hydro-

gen ion concentration, Nitrates, Photosynthesis, Indian River, Florida.

The sampling site was a Halodule wrightii seagrass bed at depths of 50-85 cm in the Indian River, Florida. Variations of dissolved ammonia and phosphate in pore water at depths of 2 to 40 cm were examined every 3 hr for 27 hr. Eh values were consistently negative and pH ranged from 7.2 to 8.0. Ammonium and phosphate were greatest at 10 cm and both steadily decreased to 40 cm. Maximum ammonium concentrations were 2.7 micro M in surface water and 169 micro M in the sediment. Maximum phophate concentrations were 6.4 micro M surface water to 30.4 micro M in sediment. Nitrate concentrations were 2.2 to 9.9 micro M at 2 cm and 0.1 to 0.8 micro M in surface waters. No nitrate was detected below 2 cm. Dynamic changes in the levels of phosphate and ammonium were observed during the period. It appears that dissolved reactive phosphorus and ammonium accumulate in sediment pore waters after photosynthesis ceases. (Moore-IVI)
W84-02252

ECOLOGICAL STUDIES ON THE FRESHWATER SHRIMP PALAEMONETES ANTENNARIUS OF LAGUNA DI LESINA (GARGANO, SOUTH ITALY),
Innsbruck Univ. (Austria). Inst. fur Zoophysiologie.
G. J. Dalla Via.
Archiv fur Hydrobiologie, Vol. 97, No. 2, p 227-239, June, 1983. 10 Fig, 2 Tab, 11 Ref.

Descriptors: *Salinity, *Shrimp, *Laguna di Lesina, *Italy, Temperature effects, Brackish water, Mediterranean Sea, Population dynamics, Lagoons, Reproduction.

The ecology of the Mediterranean fresh- and brackish water shrimp, Palaemonetes antennarius, was investigated at five localities in and around the Laguna di Lesina. Data are provided on its occurrence in the lagoon, its distribution with regard to salinity and temperature, its mortality, survival, fertility, and sex ratio. Among the 5 populations differences were found to exist in body length and sex ratio. At higher salinities growth is reduced which is considered to be due to increased costs of locomotion and maintenance. Conversely, egg development is favored by low salinities which causes the sex ratio to shift in favor of females from approximately 25% at the highest to 55% at the lowest salinity investigated. In a fresh water population (Lago di Garda) the female to male ratio is 3:1. P. antennarius avails itself of the ecological niche caused by frequent changes in salinity. No overlap with marine species was observed. (Author's abstract)
W84-02385

DIVERSITY: QUANTIFICATION AND ECOLOGICAL EVALUATION IN FRESHWATER MARSHES,
Wisconsin Univ.-Green Bay.
H. J. Harris, M. S. Milligan, and G. A. Fewless.
Biological Conservation, Vol. 27, No. 2, p 99-110, 1983. 1 Fig, 2 Tab, 38 Ref.

Descriptors: *Species diversity, *Marshes, *Birds, *Environmental quality, Green Bay, Wisconsin, Lake Michigan, Vegetation, Aerial photography, Edge diversity, Cover type diversity, Coastal areas.

The primary objective of this study was to test the usefulness of two indices - edge diversity and cover type diversity - in assessing bird species diversity for breeding avian communities in freshwater coastal marshes. Bird species diversity was used in this study as an indicator of ecological quality. Permanent transects in three marshes on the bay of Green Bay, Lake Michigan, provided the basis for vegetation assessments and breeding bird censuses. Four years of field data were subjected to regression analysis. The best equation was found to be a multiple regression of bird species diversity on cover type diversity and edge diversity, showing a significant linear relationship with cover type diversity and a significant curvilinear relationship with edge diversity. Cover type diversity and edge diversity can be readily assessed from aerial imagery. The results are most applicable to ecological evaluation where objectives stress species diversity rather than single-species management. (Author's abstract)
W84-02389

VERTICAL AND HORIZONTAL DISTRIBUTION OF MEIOFAUNA IN MANGROVE SEDIMENTS IN TRANSKEI, SOUTHERN AFRICA,
Transkei Univ., Umtata (Transkei, South Africa). Dept. of Zoology.
A. H. Dye.
Estuarine, Coastal and Shelf Science, Vol. 16, No. 6, p 591-598, 1983. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Estuarine environment, *Sediments, *Meiofauna, *Mngazana River, Transkei, South Africa, Depth distribution, Mangroves, Nematodes, Ciliates, Oligochaetes, Gastrotrichs, Polychaetes, Kinorhynchs, Crustaceans.

The depth-distribution profiles of meiofauna in four transects in the Mngazana estuary, Transkei were studied during summer 1980. Highest densities (1000/100 cu cm) were encountered within the top 10 cm of the sediment. Nematodes dominated (80%) and the remainder was made up of ciliates, oligochaetes, gastrotrichs and low numbers of polychaetes, copepods, kinorhynchs and various crustacean larvae. Among chemical parameters Eh correlated most consistantly with distribution, particularly at the lower tidal levels. Temperature and pH appeared to be of lesser importance. The maximum estimated depth of penetration was on average 72 cm at the HW levels; 32 at MW and 23 at LW. The mean dry biomass was estimated at 1073 mg/sq m; 941 mg/sq m and 196 mg/sq m at these tidal levels respectively. The meiofauna occurs to considerable depths, at least to the permanent water table. Sampling only the top 5 cm would yield approximately 40% of the total. Increasing the sampling depth to 30 cm at HWS and to 15 cm at MW would double this yield. (Moore-IVI)
W84-02398

SIGNIFICANCE OF SMALL SPECIES OF CHLOROPHYTA IN FRESHWATER PHYTOPLANKTON COMMUNITIES WITH SPECIAL REFERENCE TO FIVE WELSH LAKES,
University of North Wales, Bangor Gwynedd. School of Plant Biology.
J. Priddle, and C. M. Happey-Wood.
Journal of Ecology, Vol. 71, No. 3, p 793-810, November, 1983. 11 Fig, 2 Tab, 44 Ref.

Descriptors: *Chlorophyta, *Phytoplankton, *Lakes, *Wales, Llyn Cwellyn, Llyn Llydaw, Llyn Padarn, Llyn Coron, Llyn Maelog, Nutrients, Water quality, Mountain lakes, Mesotrophic lakes, Eutrophic lakes, Seasonal variation, Diatoms, Cyanophyta, Algal growth.

The significance of small green algae, of cell volume about 100 cu micro m, in freshwater phytoplankton was studied over an annual cycle in five lakes in North Wales which varied widely in nutrient status. Two-weekly samples from the lakes were analysed for seven water-quality variables, total phytoplankton biomass and the abundances of 131 algal taxa. The small Chlorophyta included both motile and non-motile species of Chlorococcales and Volvocales. Ankistrodesmus falcatus was the most cosmopolitan species and occasionally exceeded 1000/cu cm in all five lakes. Chlorella minutissima, C. vulgaris and Scenedesmus graheinsii also occurred in all the lakes studied but were less common than Ankistrodesmus falcatus. Some small species of Chlamydomonas and Chloromonas were restricted to one or two of the lakes. The mountain lakes, Llyn Cwellyn and Llyn Llydaw in Snowdonia had nutrient-poor waters supporting phytoplankton populations of low density. Species of small Chlorophyta were dominant numerically in the phytoplankton and were present throughout the year. The median proportions of numbers of small Chlorophyta of the total number of all other phytoplankton taxa were 87% and 91% for Llyn Cwellyn and Llyn Llydaw, respectively. Llyn Padarn, a mesotrophic lake, had a greater phytoplankton biomass than the two mountain lakes. The phytoplankton exhibited distinct seasonal periodicity, with the spring diatom growth followed by a population of Oscillatoria limnetica during the summer, and further diatom growth in the autumn. Small Chlorophyta were present through the year with population densities exceeding 10000/cu cm during the summer. The median proportion of small Chlorophyta of the total number of all phytoplankton taxa was 70%. Llyn Coron and Llyn Maelog, situated in agricultural catchments on Anglesey, were nutrient-rich; their water samples contained high concentrations of nitrogen, phosphorus and silicon compounds, particularly in the late summer and autumn. The succession of phytoplankton was dominated by taxa of larger-celled algae, mainly diatoms and buoyant blue-green algae. The phytoplankton density (as chlorophyll a) exceeded 100 mg/cu m during the spring and summer. Small Chlorophyta attained their maximum population densities, greater than 1000 organisms/cu cm, during the winter and early spring when the larger-celled algae were not recorded or were present only at low densities. During the summer the standing crop density of planktonic small Chlorophyta was low in these eutrophic lakes. (Author's abstract)
W84-02400

GROUND WATER AND THE EVOLUTION OF PATTERNED MIRES, GLACIAL LAKE AGASSIZ PEATLANDS, NORTHERN MINNESOTA,
Syracuse Univ., NY. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W84-02401

SEDIMENTOLOGY AND GEOCHEMISTRY OF RECENT SEDIMENTS OFF THE MOUTH OF THE NIAGARA RIVER, LAKE ONTARIO,
Canada Centre for Inland Waters, Burlington, Ontario.
For primary bibliographic entry see Field 2H.
W84-02405

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SINGLE-STAGE SEAWATER DESALINATION AT HIGH TEMPERATURE AND SALINITY AS PRESENT IN THE MIDDLE EAST USING PEC-1000 MEMBRANE MODULES,
Toray Industries, Inc., Shiga (Japan).
M. Kurihara, Y. Nakagawa, H. Takeuchi, N. Kanamaru, and T. Tonomura.
Desalination, Vol. 46, p 101-110, May, 1983. 4 Fig, 3 Tab, 10 Ref.

Descriptors: *Desalination, *Reverse osmosis, *Seawater, Salinity, Water temperature, Red Sea, Arabian Gulf.

In the Middle East, where desalination is needed most urgently, both salinity and temperature of the seawater are very high, presenting problems for reverse osmosis (RO) desalination. Performance and long-term durability tests were carried out at a demonstration test facility using single-stage seawater reverse osmosis (SWRO) at high salinity and temperature, using PEC-1000 membrane modules. Since the seawater salinity at the test facility is 3.5 % TDS, and the seawater salinity in the Middle East (Red Sea and Arabian Gulf) is about 4 to 5 %, a part of the brine rejected from the RO modules is recycled to control the feed water salinity for the tests. Based on the long-term field test results, PEC-1000 membrane elements exhibit sufficiently enough performance and durability for the complete single-stage seawater RO in the Middle East and the permeate salinity is low enough for the WHO standard (500 ppm TDS) even at high water recovery rate such as 35-40 %. (Moore-IVI)
W84-02150

CALCULATION OF LIMITING CURRENT DENSITY OF ELECTRODIALYSIS UNDER THE INFLUENCE OF WATER QUALITY AND TEMPERATURE,
Lanzhou Municipal Engineering Designing Inst. (China).
S. Xutong, and C. Guang.
Desalination, Vol. 46, p 263-274, May, 1983. 4 fig, 2 Tab, 6 Ref.

Descriptors: *Electrodialysis, *Desalination, *Limiting current density, Dissolved solids, Saline water, Water temperature.

Limiting current density (LCD) is an important performance index of electrodialysis equipment. When water with the same amount of TDS (total dissolved solids) but different in nature and temperature is being desalted in the same type of electrodialyzer, the LCD varies drastically. The water type coefficient for LCD is the ratio of LCD for different water types under the same electrodialysis conditions. The coefficient varies with water type, concentration of TDS, water temperature and type of membrane. For electrodialyzers with the same kind of membranes, the water type coefficient for LCD at 0 degrees C is only related to the kind of membranes, and is not affected by the concentrtion of TDS, equipment size or flow rate; it is a constant. Tests were carried out on the value of LCD using two electrodialyzers of different type. On the basis of the measured value of LCD for saline water, the values of LCD for other water types under different conditions can be calculated. The absolute values of relative error between measured and calculated values range from 0.15% to 12.2%, with an average error of 5.6%. (Moore-IVI)
W84-02152

TEMPERATURE DEPENDENCE OF MEMBRANE TRANSPORT PARAMETERS IN HYPERFILTRATION,
Max-Planck-Inst. fuer Biophysik, Frankfurt am Main (Germany, F.R.).
J.-Y. Chen, H. Nomura, and W. Pusch.
Desalination, Vol. 46, p 437-446, May, 1983. 4b Fig, 3 Tab, 15 Ref.

Descriptors: *Membrane processes, *Hyperfiltration, *Desalination, Water temperature, Membrane transport, Permeability, Salt rejection.

Using three homogeneous (CA/F-700, K-700, L-700) and two asymmetric flat sheet membranes (B-9 and SOLROX SC-200) as well as a homogeneous strong ion exchange (CK-1) and a composite membrane (Teijin PBIL), the temperature dependence (0 C <T< 40 C) of the transport parameters of the phenomenological relationships of the thermodynamics of irreversible processes, such as the hydrodynamic and osmotic permeability, and the asymptotic solute rejection, was determined from hyperfiltration experiments with 0.1 M NaCl brine solution. The salt rejection of the Ca and PBIL membranes is nearly independent of the temperature whereas the salt rejection of the SOLROX and CK-1 membranes increases with increasing temperature. The volume fluxes increase with increasing temperature for all membranes. The activation energies of water and salt transport for the different membranes used were then evaluated from the experimental data. Using aqueous KCl, MgCl2, and K2SO4 solutions, the data were supplemented by the experimentally determined enthalpies of dissolution at infinite dilution of the salt in homogeneous CA membranes. (Moore-IVI)
W84-02153

NON-CONVENTIONAL WATER SOURCES FOR SMALL REMOTE COMMUNITIES IN DEVELOPING COUNTRIES,
National Research Centre, Cairo (Egypt). Pilot Plant Lab.
A. M. Abulnour, M. H. Sorour, F. A. Hammouda, and A. M. Abdel Dayem.
Desalination, Vol. 47, p 285-292, May, 1983. 1 Fig, 3a Tab, 3 Ref.

Descriptors: *Developing countries, *Desalination, Drinking water, Potable water, Water reuse, Water management, Energy, Social aspects, Public participation, Egypt.

In Egypt, thousands of small communities are scattered in the desert and remote sea shores where conventional water sources are scarce. Means for providing clean water are vital. Further, water management and reuse schemes must be developed. Key issues to be considered when planning water supply systems include: the supply of water for drinking and cooking as a minimum; the possibility of using lower quality water for other uses by reuse; the level of technology in remote locations; the use of renewable energy sources; and sociocultural factors. The selection of potable water supply for small remote dispersed communities depends upon the specific nature of each community. Technologies based upon renewable energy should be encouraged to meet the increasing prices of fossil fuels. The potential prospects of photovoltaic systems should be considered. Any proposed solution should guarantee community participation as well as the required social orientation. Developing countries should encourage the application of these technologies by providing and encouraging the national skills as well as permitting maximal technology transfer. (Moore-IVI)
W84-02155

3B. Water Yield Improvement

PHOTOCATALYTIC FIXATION OF NITROGEN BY AQUEOUS SUSPENSIONS OF SILVER IODIDE,
Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. per la Nucleazione degli Aerosoli.
G. L. Petriconi, and H. M. Papee.
Water, Air, and Soil Pollution, Vol. 20, p 273-276, 1983. 2 Fig, 22 Ref.

Descriptors: *Nitrogen fixation, *Precipitation, *Cloud seeding, Silver iodide, Silver chloride, Chemical reactions, Photolysis, Ultraviolet radiation.

Silver iodide is the most common ice nucleant for supercooled water which now is used in weather modification and thus tons of that compound are dispersed in the air every year. Ultraviolet photolysis of silver iodide crystals was carried out in the laboratory with the expected result of nitrogen fixation. Yields of ammonium were better under experimental conditions in nitrogen than in air. At longer times of irradiation a stationary state or a decay of the ammonium concentrations ensued. This was also substantiated by the behavior of suspensions of silver chloride when irradiated in air. The aim of the present work, to show that the formation of some ammonium may be expected to occur during photolyses of silver iodide and that this substance may thus photofix nitrogen either from the gas or from the air, was accomplished. This process was compared with the corresponding behavior of silver chloride as well as considering some possible products of silver iodide decomposition. (Baker-IVI)
W84-02132

3C. Use Of Water Of Impaired Quality

PREVALENCE OF VIRAL HEPATITIS AND OTHER ENTERIC DISEASE IN COMMUNITIES UTILIZING WASTEWATER IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
B. Fattal.
Water Science and Technology, Vol. 15, No. 5, p 43-58, 1983. 6 Fig, 2 Tab, 12 Ref. EPA grant R-805174.

Descriptors: *Wastewater irrigation, *Epidemiology, *Hepatitis, *Enteric diseases, *Israel, Viruses, Effluents, Aquaculture, Shigellosis, Salmonellosis, Public health.

A retrospective epidemiological study was carried out on the association between enteric disease incidence and wastewater utilization in agriculture in 79 kibbutzim (cooperative agricultural settlements) in Israel. Medical records on disease incidence were collected directly from the patient files at the clinic of each kibbutz while environmental data was obtained from a detailed questionnaire. The kibbutzim included in the study were divided into four categories: I. thirty irrigating with wastewater effluent (population: 13,531), II. twenty-eight not utilizing effluent for any purpose (population: 11,0960, III. ten using wastewater effluent as feed-water from fish ponds (population: 5,005), and IV. eleven which practiced two consecutive years of effluent utilization and another two consecutive years in which no effluent was utilized for any purpose or vice versa (population: 3,040). No excess in crude rates of viral hepatitis was found in effluent utilizing kibbutzim (categories I and III) when compared to non-effluent utilizing kibbutzim (category II). A significant ($P<0.1$) excess of shigellosis was found in all ages in effluent irrigating kibbutzim (I) (during the irrigation period), while a significant ($P<0.01$) excess of salmonellosis was found in kibbutzim using effluent as feed-water for fish ponds (III). In the switch category (IV) there was an observed excess in crude rates of hepatitis in effluent years for age groups 5-18, 19+ and 'all ages,' although the numbers are too small to detect statistically significant differences. Despite the evidence that there was an excess of enteric diseases in kibbutzim during the period of exposure to effluent, the annual excess risk for all ages was nil or quite small, indicating that the overall risk of enteric disease resulting from effluent irrigation in kibbutzim in Israel is not a public health problem in general, though it might become one during epidemic periods. (Moore-IVI)
W84-02258

3E. Conservation In Industry

WATER RESOURCES, CURRENT CHARACTERISTICS, AND PROSPECTS OF WATER CONSUMPTION IN THE USA,
For primary bibliographic entry see Field 6D.
W84-02348

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

LOG PEARSON TYPE-3 DISTRIBUTION: PARAMETER ESTIMATION,
Asian Inst. of Tech., Bangkok (Thailand).
H. N. Phien, and M. A. Hira.
Journal of Hydrology, Vol. 64, No. 1/4, p 25-37, July, 1983. 4 Tab, 13 Ref.

Descriptors: *Flood control, *Flood frequency, Prediction, Estimating, Frequency analysis, Probability distribution, Mathematical studies, Simulation.

The log-Pearson type-3 (LP3) distribution was recommended as a base method for flood frequency analysis. Four additional methods for the estimation of the LP3 parameters, are presented. An attempt was also made to provide a suitable computational scheme for each of the methods. A simulation study was carried out using six sets of values for the parameters, selected to be in the range of those obtained from the Canadian rivers. Using a relatively large number of replications, the mean and standard deviation of relative errors committed in estimating the three parameters corresponding to each method were computed. The results indicate that when three of two moments of the transformed data are used, the resulting methods, namely the WRC (Water Resources Council method), MM3 and MM4 (mixed moments 3 and 4) produced unreliable estimates for the parameters. The method recommended by Bobee did not perform well. Among the remaining three methods, MM2, which is based on the first two moments of

original data and the variance of the log-transformed values provides the best estimates, which are only slightly better than those obtained by the method of maximum likelihood. (Baker-IVI)
W84-02199

FLOODPLAIN MANAGEMENT: STAGE OR DISCHARGE (GESTATION DES PLAINES INONDABLES: HAUTEUR OU DEBIT),
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
N. El-Jabi, and J. Rousselle.
Journal of Hydrology, Vol. 64, No. 1/4, p 93-102, July, 1983. 4 Fig, 2 Tab, 8 Ref.

Descriptors: *Flood control, *Model studies, Stochastic processes, Mathematical studies, Probabilistic process, Flood frequency, Floods, Riviere des Prairies.

A stochastic model based on the recent developments in the theory of extreme values is presented to describe the flood occurrence. This model is applied to the Riviere des Prairies, assuming that the exceedences (flood peak and/or stage above a given base flow and/or base stage) are independent and identically distributed in the time interval for a given year and season. (Author's abstract)
W84-02203

SEEPAGE FROM CANALS HAVING VARIABLE SHAPE AND PARTIAL LINING,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
A. Mirnateghi, and J. C. Bruch, Jr.
Journal of Hydrology, Vol. 64, No. 1/4, p 239-265, July, 1983. 9 Fig, 4 Tab, 8 Ref.

Descriptors: *Canals, *Seepage, Linings, Flow, Water supply development, Impervious membranes, Water management, Mathematical models.

The numerical models presented here are solutions to the steady two-dimensional flow through a porous medium from canals of variable shape with partial lining. Two main cases are studied. The first case is the seepage flow from canals with impervious lining on their sloping sides. The second case is for seepage from canals in which the impervious lining is located on the base of the canal and the sides are unlined. The Baiocchi transformation and method is used to develop a boundary value problem which is then solved by the finite-difference successive over-relaxation method with projection. A sample problem of each case is presented. The discharge rates and free surfaces of the seepage flows are obtained through the numerical scheme, and are compared with available analytical results. The formulation proved to provide a simple and efficient numerical scheme as opposed to the more complex and inefficient analytical solutions which use mapping techniques. The scheme also proved to be accurate, both the discharge rates and the free surfaces obtained were close to the analytical values obtained by mapping techniques. The numerical algorithms presented are also flexible and could be easily modified for canals of various cross sectional shapes. (Baker-IVI)
W84-02211

ASSESSMENT OF COMMONLY USED METHODS OF ESTIMATING FLOOD FREQUENCY,
D. W. Newton, and J. C. Herrin.
Transportation Research Record, No. 896, p 10-30, 1983. 19 Fig, 8 Tab, 23 Ref.

Descriptors: *Flood frequency, *Prediction, Statistical analysis, Flood flow, Tennessee Valley, Estimation, Flood peak.

Efforts to determine what are likely to be the most accurate and consistent procedures for determining peak flood flow frequencies for ungaged watersheds in the Tennessee Valley region are described. Information developed during a pilot test, which is currently the most comprehensive and objective method available of examining the performance of commonly used procedures for estimating peak flow frequencies at ungaged locations, formed the basis for this investigation. There were significant differences in performance when procedures were evaluated by using the criteria of accuracy, reproducibility, and practicality. Although the pilot test evaluation was limited to the Midwest and Northwest, the observed differences in performance result from fundamental differences in procedure formulation that can be expected to occur in the Tennessee Valley and in other regions as well. The most accurate and reproducible procedures evaluated were regression-based procedures in which prediction equations are calibrated to flood-frequency determinations at gaged locations by using statistical estimating procedures. The most obvious reasons for this superior performance are the definition of the parameters and the formulation of the prediction equation. The procedures that performed best (a) used parameters that were well-defined and could be consistently determined, (b) were formulated so that the flood-frequency estimates were not sensitive to parameter variations, and (c) were calibrated to a large number of gage records in a relatively small, well-defined hydrologic region. (Baker-IVI)
W84-02222

MAGNITUDE AND FREQUENCY OF URBAN FLOODS IN THE UNITED STATES,
V. B. Sauer, W. O. Thomas, Jr., V. A. Stricker, and K. V. Wilson.
Transportation Research Record, No. 896, p 30-33, 1983. 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Flood frequency, *Urban areas, Estimating, Regression analysis, Mathematical studies, Storm runoff, Drainage basins, Rainfall intensity, Channels, Data collections.

With urban growth and development, there is an ever-increasing need for flood information and estimating techniques for use in areas where little or no data exist. A nationwide study of flood magnitude and frequency in urban areas included reviewing available literature, compiling an urban flood data base, and developing methods of estimating urban flood-flow characteritics in ungaged areas. The literature review contains synopses of 128 recent publications related to urban flood flow. A data base of 269 gaged basins in 56 cities and 31 states, including Hawaii, contains a wide variety of topographic and climatic characteristics, land use variables, indices of urbanization, and flood-frequency estimates. Regression equations were developed that provided unbiased estimates of urban flood discharges for ungaged sites for recurrence intervals, of 2, 5, 10, 25, 50, 100, and 500 years. Of primary importance is an independent estimate of the equivalent rural discharge for the ungaged basin. The equations adjust the equivalent rural discharge to an urban condition. The primary adjustment factor, or index of urbanization, is the basin development factor. This factor is a measure of the extent of development of the drainage system in the basin and includes evaluations of storm drains, channel improvements, and curb-and-gutter streets. It offers a simple and effective way of accounting for drainage development and runoff response in urban areas. Other parameters in the equations include size of drainage area, channel slope, rainfall intensity, lake and reservoir storage, impervious area, and basin lag time. (Baker-IVI)
W84-02223

DRAINAGE CONTROL THROUGH VEGETATION AND SOIL MANAGEMENT,
E. J. Kent, S. L. Yu, and D. C. Wyant.
Transporation Research Record, No. 896, p 39-47, 1983. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Highways, *Drainage systems, Rainfall-runoff relationships, Soil properties, Runoff, Vegetation, Infiltration, Detention reservoirs, Drainage basins, Frequency distribution, South Carolina.

A procedure is developed that promotes the use of soil infiltration capacity and available soil profile storage in the design of highway drainage systems. By considering a design volume represented by the soil profile storage, the dependence on constructed runoff detention basins or other drainage structures can be reduced. This design volume is selected as the antecedent available storage in the soil that produces the T-year runoff from the T-year design rainfall. Data requirements of the overall methodology are commonly available soils, vegetation, and climatic parameters. The influence of antecedent moisture on the relation between rainfall and runoff frequency was tested by using 5 years of daily soil moisture and hourly rainfall and 10 years of hourly runoff data from the Calhoun Experimental Forest near Union, South Carolina. Equations that estimate the design antecedent moisture and its associated storage for ungaged sites are developed. Vegetation and soil management techniques that increase the volume of soil profile storage and soil infiltration capacity are reviewed. In addition, the Calhoun soil moisture data are fitted to frequency distributions to assess the risk involved in using soils-based drainage designs. (Author's abstract)
W84-02225

CONTROL OF THE LEVEL OF LAKE ISSYK-KUL,
Zh. Kulzhabaev.
Water Resources, Vol. 9, No. 4, p 364-370, July-August, 1982. 3 Fig, 1 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 41-47, July-August, 1982.

Descriptors: *Water level, *Water resources development, *Lake Issyk-Kul, USSR, Water level fluctuations, Irrigation, Water demand, Diversion, Water management.

The main consumer of water in the basin of Lake Issyk-Kul is irrigation, which accounts for more than 90% of the runoff being withdrawn. In the future it is planned to increase the areas of irrigation to meet the needs of the local population and vacationers for agricultural products, which is related to the decision of directive agencies concerning the creation on the lake of a resort zone of national importance. The level of a closed lake can be controlled by acting either on the income part of the water balance or on the outgo part. The range of fluctuations of the level of Issyk-Kul is small. The problem of optimal control of the lake level in a steady-state regime is considered, that is, when the conveyance capacity of the diversion route and nonreturnable withdrawals reach a maximum value, whereupon the steady state condition does not mean that in the future the level regime of the lake will not change. There is a need for a rapid decrease of the deficit of the water balance of Lake Issyk-Kul by diverting water from adjacent rivers to its basin. The proposed method of calculation makes it possible to substantiate both the amount of additional inflow to the lake and the optimal strategy of diverting waters. Accordingly the conveyance capacity of the diversion route which permits maintaining the lake level within the prescribed interval of heights with a given probability can be determined. Optimum control of the Issyk-Kul level requires that the capacity of the diversion route substantially exceeds the average long-term volume of diversion. This will make it possible to markedly reduce the natural range of fluctuations of the lake level caused by variability of components of the water balance. (Baker-IVI)
W84-02319

PROBLEM OF WATER SUPPLY OF THE USSR AND INTERREGIONAL REDISTRIBUTION OF WATER RESOURCES,
G. V. Voropaev.
Water Resources, Vol. 9, No. 6, p 571-593, November-December, 1982. 7 Fig, 1 Tab. Translated from Vodnye Resursy, No. 6, p 3-28, November-December, 1982.

Descriptors: *Water supply development, *Water management, *USSR, Management, Groundwater, Soil water, Brackish water, Mass transfer, Heat transfer, Water shortage, Distribution, Water supply, Reviews.

Various studies have been carried out in the Soviet Union regarding the supply of adequate water. The evaluations of the current state of natural waters were refined and their qualitative and quantitative

changes as a result of the man's impact were predicted. The estimate of the subsurface water resources was refined, additional reserves of brackish waters were revealed, and the storage of productive soil waters was analyzed. A comprehensive evaluation was made of the changes in the natural conditions in the zone of probable withdrawal of the runoff, making it possible to establish the allowable withdrawals from northern and Siberian rivers and to correct the projects underway. The need for a radical reorganization of the country's entire water management program was recognized as the understanding that simple dilution of wastes is not sufficient to restore adequate water quality. Diversion of water to Central Asia and Kazakhstan should be examined primarily in connection with the development of productive forces of the entire Middle Region of the country. On the basis of the mass and heat transfer of the river runoff and waters of northern seas, the planned withdrawals will not introduce changes in the heat balance of the region, but will cause definite changes in the mouth regions of rivers and seas. The solution of the diversion problem is impossible without the development, investigation and consideration of other hypotheses of water supply of the economy. (Baker-IVI)
W84-02335

METHODOLOGICAL PRINCIPLES OF MANAGING THE HYDROLOGIC REGIME OF THE INLAND SEAS AND LAKES,
D. Ya. Ratkovich.
Water Resources, Vol. 7, No. 6, p 593-620, November-December, 1982. 5 Fig, 6 Tab, 27 Ref. Translated from Vodnye Resursy, No. 6, p 29-58, November-December, 1982.

Descriptors: *Water supply development, *Water demand, *USSR, Water use, Lakes, Inland seas, Management, Resources development.

The majority of large river systems of the European USSR, Central Asia, and Kazakhstan empty into inland seas - closed and drainage. The increasing development of the areas, particularly for agricultural purposes, has caused changes in the natural regime of these seas as the inflow of water to them is decreasing. A new national economic problem developed as a result of these changes and efforts were made to control the regime of seas for purposes of optimization of use. Three classes of water bodies differing in the character of their regime were subject to investigation: closed (where the outgo part of the water balance includes only evaporation from the surface), open (where the outgo part of the balance includes along with evaporation the lake runoff functionally related to the level), and drainage, connected with the World Ocean where changes in the mean annual level can be neglected. The solution of the problems requires comprehensive investigations: hyrological, hydrochemical, and hydrobiological. Measures for controlling the level and average salinity are already the object of design. (Baker-IVI)
W84-02336

CURRENT PROBLEMS OF THE CREATION, MULTIPURPOSE USE, AND INVESTIGATION OF RESERVOIRS,
A. B. Avakyan.
Water Resources, Vol. 9, No. 6, p 621-635, November-December, 1982. 4 Fig, 3 Tab, 12 Ref. Translated from Vodnye Resursy, No. 6, p 74-92, November-December, 1982.

Descriptors: *Reservoirs, *Water resources development, Design criteria, Site selection, Powerplants, Training, Reservoir operation, Maintenance, Water supply.

Streamflow regulation by reservoirs and interbasin transfer of waters with their storage are seen as realistic methods of meeting the increasing demand for water in the majority of the world's regions. Reservoirs in themselves are complex in their structure and operation. The development of thermal, nuclear, and pumped-storage power stations challenges investigators of reservoirs with new problems. Solving many water resource problems and eliminating or mollifying conflicts arising during water resources management along with the creation and operation of reservoirs generates new conflicts between the sectors of water resource management. Intrasector conflicts are particularly apparent in the requirements imposed on water resources of reservoirs and regimes of releases and levels downstream of hydrostations. The impact of reservoirs on the environment is considered. Proper operator training is seen as a must for proper management. Cost effectiveness of various plans should be carefully considered at the design stage. Resettlement of inhabitants and compensation for confiscated lands, structures and other immovable property must be handled carefully and often becomes extremely complex. (Baker-IVI)
W84-02337

GRASSY SWALES PROVE COST-EFFECTIVE FOR WATER POLLUTION CONTROL,
Post, Buckley, Schuh and Jernigan, Inc., Tampa, FL.
W. C. Kercher, Jr., J. C. Landon, and R. Massarelli.
Public Works, Vol. 114, No. 4, p 53-54, April, 1983. 1 Fig, 3 Tab.

Descriptors: *Storm runoff, *Flood control, *Grassed waterways, *Grassy swales, Grasses, Water pollution control, Urban areas, Suburbs, Stormwater, Mosquitoes, Rockledge, Florida.

Evidence that grassy swales are cost effective for reducing stormwater runoff and for achieving water quality and control objectives is presented. The test site encompassed 12.7 acres of a single family residential subdivision located in Rockledge, Florida. It contains 41 single family homes, 10 vacant lots, no construction activity and portions of three roads. The soils are Myakka, Urban and Canaveral. Thirteen storm events were available for study. The grassy swale system removed 99% of the pollutants measured. In comparison with a residential drainage system in a neighboring community, the swale system greatly reduced offsite stormwater runoff. The swale system was less expensive to construct, required a smaller percentage of land area and requires less maintenance by local governments. Mosquito breeding in properly designed and maintained residential grassy swales will be minimal, as there will be no standing water. (Baker-IVI)
W84-02354

ODESSA SOLVES A WATER PROBLEM - IN A HURRY,
City Engineering Dept., Odessa, TX.
R. E. Klink.
Public Works, Vol. 114, No. 11, p 58-60, November 1983. 8 Fig, 1 Tab.

Descriptors: *Water supply development, *Population density, Odessa, Texas, Water supply, Water pressure, Pressure, Water tanks, Pipelines.

Odessa is a city in western Texas with a population of about 90,000 and over 35 sq mi in area. The town incurred an extremely rapid period of growth from the mid 1970s to the early 1980s causing a potential water shortage for a significant segment of the population. The following facilities were recommended as potential solutions to the problem: one new one-million gallon elevated water storage tank to be built 145 ft tall; a new two-million gallon ground water storage tank to be installed; one new 4.7 mgd booster pump station to be built with the capability to be easily expanded to an ultimate capacity of 14 mgd, and over one mile of water transmission lines to be built. This major public works improvement normally would have taken over two years to complete, was completed in approximately one year, due to the use of a 'fast-track' method. (Baker-IVI)
W84-02363

WATERSHED-WIDE APPROACH SIGNIFICANTLY REDUCES LOCAL STORMWATER MANAGEMENT COSTS,
Camp, Dresser and McKee, Inc., Annandale, VA.
J. P. Hartigan.
Public Works, Vol. 114, No. 12, p 34-37, December, 1983. 3 Fig, 1 Tab.

Descriptors: *Erosion control, *Channel construction, *Storm runoff, Runoff, Rainfall, Erosion, Land development, Economic aspects, Detention reservoirs.

Two approaches are described for controlling post-development runoff within downstream channels without causing significant channel erosion. Onsite control involves construction of individual stormwater detention facilities on each development site. These facilities are designed and constructed by the individual land developers to maintain peak runoff at predevelopment levels. The second approach involves constructing a single stormwater detention facility to control post-development runoff from several land development projects, and providing stream channel improvement where necessary upstream of the stormwater detention facility. Most of the advantages of the latter approach can be attributed to the need for fewer facilities in comparison with the onsite control approach. (Baker-IVI)
W84-02364

4B. Groundwater Management

EFFECT OF A SUBSURFACE BARRIER ON THE CONSERVATION OF FRESHWATER IN COASTAL AQUIFERS,
Hydraulics Research Station, Wallingford (England).
H. O. Anwar.
Water Research, Vol. 17, No. 10, p 1257-1265, 1983. 7 Fig, 11 Ref.

Descriptors: *Groundwater barriers, *Saline water intrusion, *Coastal aquifers, Safe yield, Saline-freshwater interfaces, Upconing, Freshwater outflow, Groundwater movement, Model studies, Free surfaces.

It is of practical interest in many coastal aquifers to increase the safe yield by reducing the freshwater outflow to the sea and to prevent seawater intrusion into the aquifer. This may be achieved by partially embedding an impermeable subsurface barrier parallel to the coast into the aquifer. A theoretical and experimental study was undertaken to examine the effect of a barrier on the flow field. Considerations are restricted to steady flow in an isotropic aquifer. Shape factors describing the distribution of mass density and of the velocity are introduced and their values derived. From the laboratory model study using a vertical plane Hele-Shaw model the velocity shape factor was determined. It was approximately unity for flow without a barrier, and decreased when a barrier was introduced. The barrier depressed the interface considerably and the upconing started with a higher flow rate as compared with the case without a barrier. By introducing the concept of a virtual origin it is shown that the free surface does not approach the seepage face tangentially. This was also confirmed experimentally. (Moore-IVI)
W84-02179

ANALYSIS OF DUG-WELL TEST DATA,
Center for Water Resources Development and Management, Calicut (India). Ground Water Div.
For primary bibliographic entry see Field 2F.
W84-02207

FACTORS AFFECTING THE FLOW OF AFLAJ IN OMAN: A MODELLING STUDY,
Institute of Hydrology, Wallingford (England).
Y. P. Parks, and P. J. Smith.
Journal of Hydrology, Vol. 65, No. 4, p 293-312, September, 1983. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Water resources development, *Semiarid lands, Model studies, Drainage, Tunnels, Qanats, Aflaj, Oman, Water supply, Groundwater.

Shallow sloping drainage tunnels dug into the hillsides to intercept water tables are an important source of water supply in many semi-arid coun-

tries. Two major classes are qanats sited in extensive alluvial deposits and aflaj (singular falaj) in restricted wadi gravels. A digital model is presented which represents the physical processes involved in water movement in aflaj and qanat systems, based on a numerical discretization of the transient flow equations. The adequacy of the model has been assessed by comparing its solution with the observed response of a falaj situated in northern Oman. The falaj flow reaches exponentially for the conditions found in wadi gravels. Non-exponential recession only occurs immediately after recharge and when the water table is below the height of the active length of the falaj. The recession constant increases for increasing storage coefficient and wadi width whereas it decreases for increased permeability. Thus modelling falaj flow can provide similar information on aquifer characteristics as a pumping test conducted in the aquifer. The mechanism of recharge is most closely simulated by an areally even blanket-recharge. The model predicted Al Hamra falaj flow shows a close resemblance to the available data, although these data are not adequate for rigorous testing of the model applicability. The modelling method is particularly appropriate for use as part of water-resources management study. (Baker-IVI)
W84-02452

4D. Watershed Protection

SEDIMENTATION IN BURNED CHAPARRAL WATERSHEDS: IS EMERGENCY REVEGETATION JUSTIFIED,
San Diego State Univ., CA. Dept. of Biology.
C. R. Gautier.
Water Resources Bulletin, Vol. 19, No. 5, p 793-802, October, 1983. 6 Fig, 1 Tab, 42 Ref. NSF grant DEB-7913424.

Descriptors: *Watershed management, *Chaparral, *Revegetation, *Sediment erosion, *Fire effects, California, Land management, Floods, Sedimentation, Seeding.

One of southerns California's most serious land management problems is costly and destructive discharge of sediment form recently burned chaparral watersheds. Emergency revegetation has been practiced by State and Federal land management agencies for more than 25 years at considerable public expense. The purpose of the emergency revegetation practice is to reduce heavy sedimentation that takes place in recently burned chaparrel watersheds during infrequent flooding events. A general model of chaparrel watershed erosion and sedimentation process is presented, and the results of research on emergency revegetation are reviewed within the context of the model. Seeding has a limited potential for reducing sediment yields during floods. One weakness is that seeding rarely results in an increase in plant cover. A second and more serious weakness is that seeding has a negative impact on the recover of the native vegetation. By interfering with native vegetation recovery, seeding may lead to increased rather than decreased sediment yields. Seeding should not be used as a blanket treatment whenever sediment from a recently burned watershed threatens downstream improvements. (Moore-IVI)
W84-02169

EFFECT OF SUBSURFACE DRAINAGE ON RUNOFF AND SEDIMENT YIELD FROM AN AGRICULTURAL WATERSHED IN WESTERN OREGON, U.S.A.,
Oregon State Univ., Corvallis. Dept. of Soil Science.
J. D. Istok, and G. F. Kling.
Journal of Hydrology, Vol. 65, No. 4, p 279-281, September, 1983. 8 Fig, 3 Tab, 10 Ref.

Descriptors: *Subsurface drainage, *Erosion control, *Agricultural watersheds, *Sediment yield, *Oregon, Willamette Valley, Drainage, Runoff, Storm runoff.

Continuous measurements were taken for four winter rainfall seasons of rainfall, watershed runoff and suspended sediment concentrations for three small watersheds, 0.46, 1.4, and 6.0 ha in size. The watersheds were located on the hilly western margins of the Willamette Valley, Oregon, and were fall planted to winter wheat. A subsurface drainage system was installed on the 1.4 ha watershed following two rainfall seasons. The system consisted of a patterned arrangement of 10-cm plastic tubing at a depth of 1.0 m and a spacing of 12 m. After the system was operational, perched water tables were lowered and seepage was reduced. The reductions were quantified with a watertable index (cumulative integrated excess). Watershed runoff and sediment yield from this watershed were decreased by about 65 and about 55%, respectively. These reductions were estimated from double mass curves and by statistical regression on a set of hydrograph variables. Maximum flow and average flow rates were decreased and the time from the beginning of a storm to the peak flow increased. Subsurface drainage was therefore shown to be an effective management practice for controlling erosion in western Oregon. (Baker-IVI)
W84-02451

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

USE OF CLAMS AS BIOINDICATOR OF FECAL POLLUTION IN SEAWATER,
Kuwait Inst. for Scientific Research, Safat. Dept. of Environmental Sciences.
M. J. Al-Mossawi, MH. Kadri, and A. A. Salem.
Water, Air and Soil Pollution, Vol. 20, No. 3, p 257-263, October 1983. 1 Fig, 3 Tab, 15 Ref.

Descriptors: *Clams, *Bioindicators, *Coliforms, *Salmonella, Coastal waters, Kuwait, Seawater, Circenita, Antibiotic resistance, Swimming, Water quality, Water pollution.

The coastal waters of Kuwait are widely used for bathing during the long summer season. In order to assess the water quality along the beaches, a new approach was developed. It involves the use of clam, Circenita callipyga, as a bioindicator for seawater pollution by fecal coliform bacteria (FC), antibiotic resistant fecal coliform (ABR-FC) and Salmonella spp. These organisms were detected in clam and water samples and the efficiency of clams in concentration Salmonella was confirmed. The number of FC and ABR-FC in clam and water samples were compared and a higher number was detected in clams than in water. Five isolates of Salmonella from clams were also multidrug resistant. The data suggests that clam can be used as a bioindicator of seawater pollution and is preferable to direct testing of water. The resistant to antibiotics in E. coli isolated from water and clams collected at the same time and site was of similar pattern and was determined by R-plasmid. (Author's abstract)
W84-02130

PROCEDURE FOR TESTING THE SENSITIVITY OF WATER BACTERIA TO SILVER IONS (TESTVERFAHREN ZUR PRUFUNG DER EMPFINDLICHKEIT VON WASSERKEIMEN GEGENUBER SILBER-IONEN),
Stuttgart Univ. (Germany, F.R.). Inst. fuer Siedlungswasserbau, Wasserguete- und Abfallwirtschaft.
H.-C. Flemming, and H. Rentschler.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 5, p 157-160, 1983. 4 Tab, 33 Ref.

Descriptors: *Bacteria, *Silver nitrate, Aquatic bacteria, Silver sensitivity, Bactericides.

A simple procedure for testing the silver sensitivity of water bacteria is introduced. Silver nitrate solution in various concentrations is added to the water sample and the bacterial growth of the cultures is monitored over some days. It is important to avoid nutrients or agar, because they bind silver. The total population should be used for the test. The selecting effect of the silver ions causes an alternation in the microflora favoring those species that tolerate higher silver concentrations. This corresponds with observations on applying silver compounds in practice. Routined bacteriological monitoring is recommended when these compounds are put to practical use. (Author's abstract)
W84-02142

MASS TRANSFER MODEL TO DESCRIBE LEAD CONCENTRATIONS IN DRINKING WATER,
Karlsruhe Univ. (Germany, F.R.). Engler-Bunte Inst.
A. Kuch, and I. Wagner.
Water Research, Vol. 17, No. 10, p 1303-1307, 1983. 4 Fig, 1 Tab, 26 Ref.

Descriptors: *Drinking water, *Lead, *Model studies, Mass transfer, Public health, Solubility, Pipes, Water quality.

Theoretical and practical work has been carried out on the dependence of lead solubility on water quality parameters. A mass transfer model is also presented to describe the dependence of lead concentrations on the type of drinking water supplied. Thus the amount of lead taken up by water in a lead pipe, under both stagnation and flowing conditions, can be calculated if the maximum equilibrium lead concentration and the geometry of the pipe are known. When more information of consumption patterns becomes available, it will be possible to estimate the mean lead uptake by drinking water for a typical household by calculation. The following data will be needed for every service pipe in order to successfully make decisions on priorities for pipe replacement: length and diameter of pipe, water consumption pattern in the house, number of adults and children in the house, maximum equilibrium lead concentration for the distributed water quality. Additional work on consumption patterns is necessary before any final recommendations on pipe replacement can be made. (Baker-IVI)
W84-02182

METHOD FOR CALCULATING EFFECTS, ON AQUATIC ORGANISMS, OF TIME VARYING CONCENTRATIONS,
Manhattan Coll., Bronx, NY.
J. L. Mancini.
Water Research, Vol. 17, No. 10, p 1355-1362, 1983. 13 Fig, 1 Tab, 15 Ref. EPA Cooperative Agreement 806828.

Descriptors: *Toxicity, *Aquatic animals, *Bioassay, Mortality, Water pollution effects.

A method is presented for calculation of the effects, on aquatic organisms, of exposure to time variable concentrations of toxicants. The technique employs data from classical bioassay tests obtained using constant toxicant concentrations. Calculations of organism mortality as a result of exposure to time varying concentrations are compared to observed data providing a test of the proposed method. The calculation procedure employs available data to assess the duration and extent of carry over effects from individual exposures. The proposed framework can be employed to calculate the probable mortality and the percentage of mortality stress anticipated from exposure to any time history of toxic concentrations. The framework assumes that the effects of an exposure, before death, are reversible. The effects of very high exposure concentrations for short durations may not always be reversible. The method allows utilization of the existing bioassay data base, both chronic and acute, to predict effects associated with time varying exposure concentrations. (Moore-IVI)
W84-02185

COMPARISON OF SEVERAL MICROBIOLOGICAL TOXICITY SCREENING TESTS,
National Water Research Inst., Burlington (Ontario).
B. J. Dutka, N. Nyholm, and J. Petersen.
Water Research, Vol. 17, No. 10, p 1363-1368, 1983. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Toxicity, *Bioindicators, Microorganisms, Dichlorophenol, Cetyl trimethyl ammonium chloride, Sodium lauryl sulfate, Phenol, Copper sulfate, Mercury chloride, Zinc sulfate, Microtox system, Spirillum volutans, Sludge.

Four short-term microbiological toxicity screening tests were compared using the following test chemicals: 3,5 dichlorophenol, cetyl trimethyl ammonium chloride, sodium lauryl sulfate, phenol, copper(II) sulfate, mercury(II) chloride and zinc(II) sulfate. These seven chemicals represent a wide range of toxicity. The methods examined were Beckman's Microtox system, the Spirillum volutans motility test, inhibition of respiratory activity of activated sludge, and inhibition of activated sludge TTC-dehydrogenase activity. The results obtained indicate that each method has its own toxicity sensitivity pattern, and among the substances tested, only mercury(II) chloride and phenol were ranked equally by the four methods as the most and the least toxic chemical, respectively. In a tentative ranking of the methods, according to sensitivity, the Microtox test came out as the most sensitive test, followed by the Spirillum test, which in turn appeared more sensitive than the two sludge tests. This ranking has meaning only in a statistical sense, however, and the variable nature of the results support the philosophy that for assessing toxicity more thoroughly, a battery of several tests is required. (Author's abstract)
W84-02186

FIELD INSTRUMENTATION FOR MONITORING WATER-QUALITY EFFECTS OF STORMWATER RUNOFF FROM HIGHWAYS,
For primary bibliographic entry see Field 6G.
W84-02228

TOXIC SUBSTANCE MONITORING IN THE INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Foundation, Inc., Fort Pierce, Florida.
T. C. Wang.
Florida Scientist, Vol. 46, No. 3/4, p 286-295, 1983. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Chlorinated pesticides, *Polychlorinated biphenyls, *Pollutant identification, *Indian River Lagoon, Florida, Water pollution sources, DDT, Sediments, Malathion, Parathion, Hydrogen ion concentration, Water temperature, Salinity, Organic compounds.

Investigation of chlorinated pesticides and polychlorinated biphenyls (PCBs) in samples of water and sediment were made near sewage and power plant outfalls, freshwater tributaries, and agricultural runoff canals located along the Indian River between Vero Beach and St. Lucie Inlet (Florida). Chlorinated pesticide residues and PCB were not detected in surface water samples. Concentrations of several compounds such as DDT and PCB (Aroclor 1254) were low in sediment samples (<0.1 ppm), although they were detected at least once in most samples. The persistence of malathion and parathion decreased with increasing pH and salinity. When temperature was above 26 degrees C and salinity above 20 ppt, hydrolysis was the predominant pathway of degradation of malathion and biological interaction was the most significant pathway of degradation for parathion. Industrial chemicals such as trichloroethylene and other volatile organic compounds are currently being monitored in the Main Relief Canal and Indian River at Vero Beach. Background levels of trichloroethylene were low in both water and sediment samples (<0.1 ppb and approximately = 0.5 ppb, respectively). (Author's abstract)
W84-02251

SELECTION OF PRACTICAL INDICATOR SYSTEMS FOR MONITORING THE VIROLOGICAL QUALITY OF POTABLE WATER, WASTEWATER, SOLID WASTE, SHELLFISH, FISH AND CROPS,
Cincinnati Univ., OH. Dept. of Civil and Environmental Engineering.
P. V. Scarpino.
Water Science and Technology, Vol. 15, No. 5, p 17-32, 1983. 5 Tab, 69 Ref.

Descriptors: *Viruses, *Bioindicators, *Water analysis, *Wastewater analysis, Potable water, Indicators, Monitoring, Bacteria.

The actual detection of viruses or the use of an indicator system or systems to assess the presence of pathogenic viruses in contaminated environments is essential for the protection of human health. An ideal microbial indicator for assessment of viral presence should include the following properties: applicability in all types of environments, present whenever viral pathogens are present, have a reasonably longer survival time than the hardiest enteric viral pathogen, should not reproduce in the contaminated environment, and should be harmless. The possible surrogate relationships between pathogenic viruses and bacterial indicators of fecal pollution in the diverse environments of potable water, wastewater, solid waste, shellfish, fish and crops are considered. Assessments are made concerning the reliability of the indicator to identify in these diverse environments viral presence. Thus far no one has demonstrated a convincing relationship between the numbers and/or types of different indicator bacteria and the pathogenic viruses themselves. The search should continue for more acceptable alternatives which would eliminate the need for the more difficult and time consuming direct testing of pathogenic virus presence. the best indicator for pathogenic virus presence may be the virus itself. (Moore-IVI)
W84-02256

PUBLIC HEALTH, FINANCIAL AND PRACTICAL CONSIDERATIONS OF VIROLOGICAL MONITORING AND QUALITY LIMITS,
Ohio State Univ., Columbus. Dept. of Civil Engineering.
O. J. Sproul.
Water Science and Technology, Vol. 15, No. 5, p 33-41, 1983. 3 Tab, 27 Ref.

Descriptors: *Viruses, *Monitoring, *Water quality standards, Public health, Water treatment, Disinfection, Drinking water.

The recent literature on virus monitoring and virus standards for water are reviewed, and the information is extrapolated from field operating conditions. Virus standards appear to be in use or have been proposed in Arizona and Maryland in the United States, South Africa and the European Economic Community. There appears to be a minimal infective dose for each virus for a particular individual, but extrapolation of such a value to a large population is difficult. Costs of monitoring for viruses using present techniques are very high compared to coliform tests. If virus standards are established, then routine monitoring should be required to assure compliance with the standard. Extreme care must be taken in establishing virus standards since there is little documented evidence to support the conclusion that virus infections result from consuming an adequately treated water. Frequency of monitoring in drinking water should be established in accordance with the intent of the virus standard. The virus level which might be present in water from a modern, well-operated treatment plant may be so low that infections or diseases contracted from it are undetectable from the background contracted from other sources. It is important that monitoring and quality requirements be based on demonstrated facts. Such will assure an adequacy of water treatment but not in excess of that which is needed and which can be justified. The opposite is frequently counterproductive since the contempt which is bred for ill-advised regulations may result in lessening attention to other critical operational requirements. (Moore-IVI)
W84-02257

DEVELOPMENTS IN METHODS FOR THE DETECTION OF VIRUSES IN LARGE VOLUMES OF WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass.
Water Science and Technology, Vol. 15, No. 5, p 59-67, 1983. 40 Ref.

Descriptors: *Viruses, *Pollutant identification, Filtration, Membrane processes, Public health, Water quality control, Water analysis.

Recent developments in virus concentration methodology are reviewed. Evaluations of virus recovery by electronegative and electropositive membrane filters as well as other methods of virus concentration reported in recent literature are discussed. Many different techniques have been developed for virus concentration from water and these may be divided into those processes able to handle large volumes of water and those useful for smaller volumes. Membrane filtration is generally the most rapid and convenient for large volume field sampling. Electropositive filter media have been studied for virus recovery efficiency. Animal viruses have been concentrated from 19 liters of activated sludge effluent by Zeta plus 30S and MDS cartridge filters without modification of the water prior to filtration. Magnesium chloride has enhanced poliovirus adsorption to Filterite filters. Zeta plus 60S filters have been incorporated into a portable virus concentrator and tested in 500 liter samples of fresh water. Seitz filters were able to efficiently adsorb poliovirus from tap water at a pH range of 3.5 to 9.0. Positively charged chrysotile asbestos 47 mm filters concentrated poliovirus type 1 and coliphage f2 from 20 liters of tap water, pH 7.8 with average recovery efficiencies of 68% and 65%, respectively. A number of eluents have been compared for recovery of virus adsorbed to filters. Other virus concentration methods discussed include ultrafiltration, the Pellicon cassette recirculating flow molecular filtration system, the use of Talc-Celite, adsorption to a bed of iron oxide sandwiched between two filters, polyethylene glycol hydroextraction, organic flocculation, and aluminum hydroxide adsorption/precipitation. (Baker-IVI)
W84-02259

HUMAN ENTERIC VIRUSES ISOLATED FROM INFLUENTS OF SEWAGE TREATMENT PLANTS IN S. PAULO, BRAZIL,
Companhia de Tecnologia de Saneamento Ambiental, Sao Paulo (Brazil).
M. T. Martins, L. A. Soares, E. Marques, and A. G. Molina.
Water Science and Technology, Vol. 15, No. 5, p 69-73, 1983. 1 Tab, 33 Ref.

Descriptors: *Wastewater analysis, *Viruses, *Enteroviruses, *Sao Paulo, *Brazil, Poliovirus, Echoviruses, Coxsackie virus.

From April 1979 to May 1980, 55 sewage samples were collected from influents of a sewage treatment plant in Sao Paulo, Brazil which receives 12% of the total domestic sewage of Sao Paulo city. From the 55 sewage samples, 433 virus strains have been isolated, including 70.7% poliovirus, 19.2% echovirus, 7.6% coxsackievirus, and 2.5% untyped. Five different methods were used for virus recovery: adsorption to and elution from membrane filters; acidic precipitation; concentration through membrane filters, with reconcentration by organic flocculation; concentration on aluminum hydroxide; aluminum sulfate precipitation. The sewage sample was plaqued in bottle cultures on BS-C-1 cell line. This cell line allowed a recovery of 22 different serotypes of enteroviruses: the three poliovirus types, 14 types of echoviruses, four types of coxsackie B virus and one type of coxsackie A virus. The sewage examined receives contributions from areas of medium to high socioeconomic levels, and also from hospitals and industries. Massive oral vaccination against poliovirus is done yearly. This may explain the high percentage of poliovirus in these samples. (Moore-IVI)
W84-02260

VIRUS CONCENTRATION FROM WATER USING HIGH-RATE TANGENTIAL-FLOW HOLLOW FIBER ULTRAFILTRATION,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemical and Environmental Engineering.
D. M. Dziewulski, and G. Belfort.

Water Science and Technology, Vol. 15, No. 5, p 75-89, 1983. 5 Fig, 2 Tab, 20 Ref. NSF grant ENG-7826588.

Descriptors: *Virus concentration, *Ultrafiltration, *Water analysis, Poliovirus, Turbidity, Membrane processes.

The efficacy of tangential flow hollow fiber ultrafiltration (TFHFU) as a means of concentrating poliovirus 2 (Sabin) from large volumes of tap water was studied. Initially, hydrodynamic studies using 50-l tap water feed solutions were conducted to evaluate transmembrane flux as a function of axial flow rates (or Reynold's numbers, Re). With increasing Reynold's number, flux-decline rates were reduced. As a result, experimental duration was shortened from 110 min at Re=300 to 30 min at Re=1728. In all cases, radical flow was assisted by a vacuum force applied to the outside of the hollow fibers. Virus recovery capability was evaluated using 20-, 50- and 100-l feed samples seeded with poliovirus 2 from 604 to 0.5 pfu/ml. All virus experiments were conducted at Re=1728 and a vacuum force of 32,700 Pa. The mean duration of the 20-, 50-, and 100-l experiments was 13, 42, and 79 minutes, respectively. The overall average virus recovery from all experiments was 69.1 + or - 24.6%. In operating the tangential-flow hollow fiber ultrafiltration module in its normal recycle-mode with low turbidity waters (<20 NTU), the expected steady flux-decline resulting from membrane fouling was not observed. Instead, the transmembrane permeation flux was maintained at a relatively constant value especially near the end of the experiments when the solute concentration in the feed increased the fastest. Increased feed water temperature resulting from the addition of pumping energy during recycle is responsible for this unexpected advantage. Final temperatures never exceeded a point at which virus inactivation would occur. For high turbidity feed waters (75 to 85 NTU), obtained by the addition of kaolin clay, virus recoveries varied from 30 to 49%. Final turbidities at the termination of a 50-l run were from 950 to >1000 NTU. In spite of high turbidity, the mean experiment duration for dehyrating 50 liters of turbid feed water was 39 minutes; approximately the same as for the low-turbidity tap water runs. (Author's abstract)
W84-02261

STANDARD METHOD FOR QUANTIFICATION OF EARTHY-MUSTY ODORANTS IN WATER, SEDIMENTS, AND ALGAL CULTURES,

Metropolitan Water District of Southern California, La Verne, CA. Water Quality Branch.
S. W. Krasner, C. J. Hwang, and M. J. McGuire.
Water Science and Technology, Vol. 15, No. 6-7, p 127-138, 1983. 5 Fig, 7 Tab, 18 Ref.

Descriptors: *Odor, *Water analysis, *Sediments, *Algae, Closed-loop stripping analysis, Gas chromatography, Mass spectrometry, Earthy odor, Musty odor, Geosmin, Methyliosborneol, Taste.

Objectionable tastes and odors in drinking water are a common and widespread problem, with odors described as muddy or earthy-musty usually representing the most troublesome occurrences. Microbial metabolites from the microorganisms that exist in a drinking water system often are the cause of these problems. Closed-loop stripping analysis (CLSA), in combination with gas chromatography - mass spectrometry (GC/MS), has been used in the determination of five earthy-musty-smelling compounds (geosmin, 2-methylisoborneol, 2-isopropyl-3-methoxy pyrazine, 2-isobutyl-3-methoxy pyrazine, and 2,3,6-trichloroanisole). One-liter water samples are analyzed within 3 hours, with detection limits as low as 2 ng/l each. Precision and accuracy levels of 20% or better are obtainable with this method. This technique has been modified to include the CLSA of sediments and laboratory-grown microbiological cultures in order to investigate the sources of the odorous compounds. CLSA-GC/MS provides a valuable tool for extended surveys and regular monitoring of water supplies, and it is indispensable in the understanding and management of earthy-musty taste and odor problems. (Moore-IVI)
W84-02274

STRIPPING TECHNIQUES FOR THE ANALYSIS OF ODOUROUS COMPOUNDS IN DRINKING WATER,

Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society.
R. Savenhed, H. Boren, A. Grimvall, and A. Tjeder.
Water Science and Technology, Vol. 15, No. 6-7, p 139-148, 1983. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Odor, *Water analysis, *Drinking water, *Stripping method, Gas chromatography, Mass spectrometry, Aldehydes, Ketones, Alcohols.

The closed loop stripping method was modified to improve the concentration of odorous compounds from drinking water. The main modification was the change from the closed loop to the open stripping system. The open stripping system has two advantages; the blank level is significantly lower and it is easier to use higher stripping temperatures. Sensory analysis of stripped waters and concentrates of stripped compounds under standard conditions (30 C, 2 hr) showed that the yield of odorous compounds increased substantially at elevated stripping temperatures and prolonged stripping times. Chemical analysis showed an increased recovery of semipolar compounds, e.g. aldehydes, ketones and alcohols. Raw and treated surface waters have been analysed. Capillary gas chromatography and mass spectrometry were used for the separation and identification. (Moore-IVI)
W84-02275

COMPARISON OF SORPTION AND EXTRACTION METHODS FOR RECOVERY OF TRACE ORGANICS FROM WATER,

Saskatchewan Univ., Saskatoon. Dept. of Biology.
V. C. Blok, G. P. Slater, and E. M. Giblin.
Water Science and Technology, Vol. 15, No. 6-7, p 149-159, 1983. 1 Fig, 6 Tab, 33 Ref.

Descriptors: *Sorption, *Solvent extraction, *Water analysis, *Organic compounds, Adsorbents, Trace compounds.

Several commercially available adsorbents were compared with solvent extraction methods for their utility in recovering trace organics from water. The adsorbents examined included Amberlite XAD-2, XAD-4 and XAD-8, Ambersorb XE340 and XE348 and Tenax-GC. All were found to produce high artifact levels, even after extensive clean-up, making them unsuitable for the analysis of trace organics in water. Quantitatively, Likens-Nickerson (Am. Soc. Brewing Chem. Proc., 1964, 5-13) or continuous liquid-liquid extraction with methylene chloride gave better recoveries than the adsorbents. Qualitatively, extractive methods were preferred as they yielded much lower levels of impurities than the adsorbents. These methods of recovering trace organics were evaluated using a standard mixture of compounds added to the water at a level of 55 micro g/l. Likens-Nicherson extraction gave comparable recoveries of this mixture at 55 micro g/l and 11 micro g/l. (Author's abstract)
W84-02276

COMPOSITION OF FISH FILLETING WASTEWATER,

Centro de Investigaciones de Tecnologia Pesquera, Mar del Plata (Argentina).
J. F. Gonzales, E. M. Civit, and H. M. Lupin.
Water South Africa, Vol. 9, No. 2, p 49-56, April, 1983. 18 Fig, 5 Tab, 15 Ref.

Descriptors: *Pollutant identification, *Food-processing wastes, *Effluents, Industrial wastes, Water pollution control, Seasonal variation, Phosphates, Nitrogen, Nitrate, Fisheries, Argentina.

Fish processing plants, particularly filleting, have developed in Argentina during the last few years. Wastewater from the plants in close proximity to urban areas is discharged to the sewer or harbor without treatment. The composition and seasonal variability of liquid effluents from hake filleting plants were studied as a first step in pollution control. Analyses for temperature, pH, settleable matter, total residue, grease and oil, phosphate, total Kjeldahl nitrogen, ammonia, nitrate, nitrite, BOD5 and COD were performed on 22 samples taken from June 1980 to May 1981. Data were statistically analysed. Operational policy appears to have a decisive influence on the composition of the wastewater. Moreover, seasonal variation, which could be correlated to raw material seasonal changes, was detected for grease and oil. (Baker-IVI)
W84-02304

METAL SURVEYS IN SOUTH AFRICAN ESTUARIES; VII BUSHMANS, KARIEGA, KOWIE AND GREAT FISH RIVERS,

Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water South Africa, Vol. 9, No. 2, p 66-70, April, 1983. 1 Fig, 5 Tab, 9 Ref.

Descriptors: *Trace metals, *Estuaries, *South Africa, Bushmans River, Kariega River, Kowie River, Great Fish River, Sediments.

Surveys to study the distribution of selected metals in the Bushmans, Kariega, Kowie and Great Fish Rivers were carried out in the period August 1978-April 1979. Surface sediment and water samples and sediment cores were analysed for up to sixteen elements using atomic absorption spectroscopy. Interelement relationships as well as absolute metal concentrations were examined before interpreting the data obtained. Metal concentrations in sediment and water samples from the four rivers are normal for unpolluted Eastern Cape rivers and such conditions are likely to be maintained in the absence of further urbanization or industrialization. Relatively elevated metal levels were found at sites upstream from the river mouths but interelement ratios for these samples suggest that the metals are not anthropogenic but are derived from weathering of catchment rocks. Metal levels in sediment do not vary greatly with depth. (Baker-IVI)
W84-02306

APPLICATION OF A TETRAHYMENA PYRIFORMIS BIOASSAY SYSTEM FOR THE RAPID DETECTION OF TOXIC SUBSTANCES IN WASTEWATERS,

National Inst. for Water Research, Pretoria (South Africa).
J. L. Slabbert, R. Smith, and W. S. G. Morgan.
Water South Africa, Vol. 9, No. 3, p 81-87, July, 1983. 4 Fig, 7 Tab, 16 Ref.

Descriptors: *Monitoring, *Bioassay, *Wastewater analysis, *Toxicity, Effluents, Wastewater treatment, Tetrahymena, South Africa.

Decontamination of samples is a necessary step in the bioevaluation of heavily contaminated water samples in order to interpret toxic effects on oxygen uptake rate. A bioassay technique based upon the respiratory response of Tetrahymena pyriformis to intoxication was used to evaluate the quality of a number of effluents from three wastewater treatment plants in the Pretoria-Johannesburg area (South Africa). With this technique results are obtained within 10 min. Toxic activity was detected in both treated and untreated wastewater effluent. The technique was sufficiently sensitive to monitor toxicity in raw and treated wastewater effluent, and to evaluate the efficiency of the various treatment stages to remove toxicants from raw waters. A comparison of toxic effects with the concentration of individual chemical substances present after addition of the test samples to cell suspensions, showed the effects of wastewater effluents on respiration rates of the test organism could be attributed to the overall chemical activity rather than to the presence of individual toxicants. (Baker-IVI)
W84-02307

PRECIPITATE FLOTATION OF TRACE PHOSPHATE ION IN WATERS,

Tokyo Metropolitan Univ. (Japan). Dept. of Industrial Chemistry.
M. Aoyama, T. Hobo, and S. Suzuki.

Analytica Chimica Acta, Vol. 153, p 291-295, 1983. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Pollutant identification, *Phosphates, Flotation, Natural waters, Spectrophotometry, Chemical precipitation.

A flotation-spectrophotometric method is described for the determination of soluble inorganic phosphate in freshwaters. Phosphate (5-150 micrograms/liter) in 1 liter samples is coprecipitated with aluminum hydroxide at pH 8.5. The precipitate is floated with the acid of sodium oleate and nitrogen, separated, and dissolved in 1M sulfuric acid. Phosphate is determined by a conventional method using molybdenum blue. Recoveries are better than 95% and the relative standard deviation is about 1%. The time required for the whole process is about 50 minutes for one sample. The method offers a rapid and precise means for the routine determination of phosphate in freshwaters. With suitable modification the procedure may also be applicable to sea water. (Baker-IVI)
W84-02379

COMPARISON OF METHODS FOR THE DETERMINATION OF LEAD IN POTABLE WATERS BY ELECTROTHERMAL ATOMIC ABSORPTION SPECTROMETRY WITH LANTHANUM MATRIX MODIFICATION AND STANDARD ADDITION PROCEDURES,
South Staffordshire Waterworks Co., Walsall (England).
I. J. Fletcher.
Analytical Chimica Acta, Vol. 154, p 235-249, 1983. 7 Fig, 7 Tab, 17 Ref.

Descriptors: *Lead, *Water analysis, *Lanthanum matrix modification, *Potable water, Water quality, Pollutant identification, Atomic absorption spectroscopy.

The determination of lead by electrothermal atomic absorption spectrometry was investigated for 30 different borehole and surface water samples by using direct, standard addition and lanthanum matrix modification procedures. In the direct method, suppressive interference was evident for most samples. In some case suppression could be directly related to the constitution of the sample. Nitric acid and lanthanum (as the chloride or nitrate) were added to samples to overcome interferences in the direct determination. Source waters that exhibited severe suppression were used to optimize the concentrations of lanthanum and nitric acid (0.05% and 0.4%, respectively) required to effect full recovery of lead. The optimized procedure was evaluated during routine operation over a 6-month period with quality control samples and was shown to satisfy the required performance criteria for the determination of lead in potable waters. The method was superior to manual and automated standard addition procedures. (Author's abstract)
W84-02380

ENUMERATION OF THERMOTOLERANT COLIFORMS IN WATER USING DESOXYCHOLATE AGAR AT 43 DEGREES C,
Tokyo Univ. (Japan). Dept. of Food Science and Technology.
A. Hiraishi, K. Saheki, and S. Horie.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 49, No. 8, p 1297, August, 1983. 1 Tab, 1 Ref.

Descriptors: *Coliforms, *Water quality control, Thermophilic bacteria, Bacteria, Tokyo, Wastewater, Sludge.

An attempt was made to use desoxycholate agar (DA) with incubation at 43 degrees C for the selective growth and enumeration of thermotolerant coliforms (TTC). The usefulness of the elevated temperature DA plate method for enumerating TTCs in different waters was evaluated. Water samples were collected from several points in Tokyo. Similar or higher average TTC counts were obtained from river water, estuary water, raw sewage, and activated sludge effluent samples by the elevated temperature DA plate method as compared to those estimated by the most probably number procedure. However, the former method gave a far lower average count than did the latter when examining mountain stream water samples. (Baker-IVI)
W84-02391

IDENTIFICATION AND DETERMINATION OF TRACE ORGANIC SUBSTANCES IN SEDIMENT CORES FROM THE WESTERN BASIN OF LAKE ONTARIO,
National Water Research Inst. Burlington, Ontario.
F. I. Onuska, A. Mudroch, and K. A. Terry.
Journal of Great Lakes Research, Vol. 9, No. 2, p 169-182, 1983. 13 Fig, 5 Tab, 14 Ref.

Descriptors: *Path of pollutants, *Organic compounds, *Lake Ontario, *Niagara River, *Sediment transport, Aromatic compounds, Dioxin, Alkylated benzenes, Phthalates, Esters, Olefins, Aldehydes, Chlorobenzenes, Benzoates.

Sediment cores were obtained at five sampling stations, and samples were extracted by the base/neutral and acid method designed by the EPA for extraction of water samples. The identification of organic compounds in the base/neutral sediment extract was carried out by GC/MS techniques. The major classes of investigated contaminants were aromatics, polynuclear aromatics, alkylated polynuclear aromatics, alkylated benzenes, phythalates, methylesters of fatty acids, olefins, aldehydes, chlorobenzenes, and benzoates. In addition, all sediment samples were analysed for 2,3,7,8-tetrachloro dibenzo-p-dioxin (TCDD) In the surface sediments, the abundance of contaminants decreased with the distance from the Niagara River mouth toward the north-west. High concentrations of most of the detected organics were present in sediment at the station located east of the river mouth. A measurable quantity of 2,3,7,8-TCDD equivalent was present in surface sediment (0 to 3-cm depth) at one station in the vicinity of the Niagara River mouth and in subsurface sediment at a station located east of the river mouth. Particle size distribution and geochemistry of the sediment were similar in al samples and were not responsible for the variations in concentration of individual organic compounds. Results indicate a major transport of organic pollutants toward the east of the Niagara River mouth; transport of sediment-associated pollutants exists to a small extent in the northwest direction from the river mouth. (Moore-IVI)
W84-02407

VOLATILE CONTAMINANTS IN THE WELLAND RIVER WATERSHED,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
For primary bibliographic entry see Field 5B.
W84-02415

CHLORINATED HYDROCARBONS IN THE SURFACE MICROLAYER OF THE NIAGARA RIVER,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
R. J. Maguire, K. W. Kuntz, and E. J. Hale.
Journal of Great Lakes Research, Vol. 9, No. 2, p 281-286, 1983. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Chlorinated hydrocarbons, *Surface microlayer, *Suspended solids, *Niagara River, Hepachlor epoxide, Endosulfan, Polychlorinated biphenyls, Dieldrin, BHC, Pesticides, Water pollution sources, Lake Ontario.

Concentrations of 18 chlorinated hydrocarbons were determined in the surface microlayer, subsurface water, and suspended solids at five stations along the length of the Niagara River in July 1981. The concentration of heptachlor epoxide in the unfiltered surface microlayer was greater than that in unfiltered subsurface water at all five stations by factors of 138 to 225; alpha-endosulfan and 'total PCB' were similarly enriched in the surface microlayer at two stations each, by factors of up to 203 and 32, respectively. In addition, mass balances for the 18 compounds in the three 'compartments' sampled showed that (i) at three stations there was more heptachlor epoxide in the unfiltered surface microlayer than associated with those suspended solids which were collected with a continuous flow separator from a depth of 1 to 2 m, and (ii) there was far more alpha- and gamma-BHC, dieldrin, and 'total PCB' present in unfiltered subsurface water than associated with the suspended solids. This latter finding in particular necessitates a revision of earlier estimates of loading of at least some chlorinated hydrocarbons to Lake Ontario from the Niagara River, based solely on concentrations in the suspended solids fraction sampled with the same continuous flow separator. (Author's abstract)
W84-02416

ORGANOCHLORINE CONTAMINANT RESIDUES IN SPOTTAIL SHINERS (NOTROPIS HUDSONIUS) FROM THE NIAGARA RIVER,
Ontario Ministry of the Environment, Rexdale. Water Resources Branch.
K. Suns, G. R. Craig, G. Crawford, G. A. Rees, and H. Tosine.
Journal of Great Lakes Research, Vol. 9, No. 2, p 335-340, 1983. 3 Fig, 2 Tab, 8 Ref.

Descriptors: *Shiner, *Organochlorine compounds, *Pollutant identification, *Niagara River, Frenchmans Creek, Polychlorinated biphenyls, Mirex, Chlorinated benzenes, Octachlorostyrene, Dioxin, Pesticide residues, Cayuga Creek, New York, Lake Ontario, Water pollution sources.

Collections of young-of-the-year spottail shiners (Notropis hudsonius) were used to determine spatial distribution (1981) of organochlorine residues and their temporal trends in the Niagara River. PCB and mirex residues in spottail shiners ranged from 164 to 573 ng/g and non-detectable to 18 ng/g, respectively. PCB and mirex residues exceeded the aquatic life objectives (Great Lakes Water Quality Agreement of 1978) at all sites except Frenchman's Creek, where mirex was non-detectable. Residues for heptachlor, heptachlor epoxide, aldrin, endrin, chlordane, thiodan, dieldrin, BHC, and DDT were low or non-detectable in Niagara River spottail shiners. Chlorinated benzene and octachlorostyrene residues were also present in most Niagara River spottail samples analyzed. Dioxin (2,3,7,8-TCDD) was present in all Niagara River spottail shiner collections and ranged from 4 to 60 pg/g. The highest dioxin residues were found at Cayuga Creek, N.Y. PCB residues have declined significantly since 1975 in Niagara-on-the-Lake spottail shiners; however, residues increased in 1980 and 1981, although they were below the 1975 concentrations. Mirex residues in spottail shiners from Niagara-on-the-Lake have also declined significantly since 1978, suggesting reduced mirex inputs to Lake Ontario. (Author's abstract)
W84-02422

DETECTION OF PARTICLE-ASSOCIATED ENTEROVIRUSES FROM RAW AND TREATED SEWAGE AND LAKE MICHIGAN HARBOR WATER,
Wisconsin Univ.-Milwaukee, Dept. of Zoology/Microbiology.
L. E. Guskey.
Journal of Great Lakes Research, Vol. 9, No. 4, p 468-473, 1983. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Enteroviruses, *Suspended solids, *Wastewater analysis, *Water analysis, Viruses, Poliovirus, Chlorination, Particulate matter, Milwaukee Harbor, Wisconsin.

Suspended solids from raw sewage, various stages of wastewater treatment, and Milwaukee Harbor water were examined for associated enteroviruses. The solids were sedimented by centrifugation, and enteroviruses associated with them were eluted by homogenization in fetal bovine serum, analyzed quantitatively by plaque assay on Buffalo green monkey kidney cells, and identified by neutralization with Lim Benyesh-Melnick pooled antisera. Viruses were found at concentrations within approximately one order of magnitude in sediments from all samples. Nine different enteroviruses were

identified. All three types of poliovirus were detected in terminally treated (chlorinated) sewage, but the temperature-sensitive marker was not detected in the poliovirus strains isolated from chlorinated samples. Together these data indicate that exploitation of the association of viruses with suspended particles leads to a simple rapid means of monitoring virus distribution in sewage and natural waters. (Author's abstract)
W84-02430

5B. Sources Of Pollution

FATE OF METALS INTRODUCED INTO A NEW ENGLAND SALT MARSH,
Marine Biological Lab., Woods Hole, MA.
A. E. Giblin, I. Valiela, and J. M. Teal.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 81-98, July 1983. 8 Fig, 4 Tab, 40 Ref.

Descriptors: *Salt marshes, *Fertilizers, *Sludge, *Heavy metals, Fate of pollutants, Spartina, Crabs, Mussels, Sediments, Solubilization, Copper, Cadmium, Zinc, Iron, Manganese, Chromium, Lead, Great Sippewissett Marsh, Massachusetts.

As part of a study to investigate the effect of chronic eutrophication on salt marshes, a sewage sludge fertilizer has been applied to experimental plots in Great Sippewissett Marsh, MA, since 1974. The fertilizer contains substantial amounts of heavy metals. Sediments from fertilized plots contain elevated levels of Cu, Cd, Zn, Fe, Mn, Cr, and Pb. The above- and below-ground portions of the dominate grass, Spartina alterniflora, contain significantly higher levels of Cd, Cr, Cu, and Zn when compared to control plots. The mussel, Modiolus demissus, from fertilized plots contains elevated levels of Cu, Cd, and Cr. The fiddler crab, Uca pugnax contains more Cu and Cd than control animals. Low marsh sediments fertilized for 8 yr retained 15% Cd, 24% Fe, 27% Mn, 28% Zn, 45% Cr, 49% Cu, and 60% of the Pb in the fertilizer. Plots which had only received fertilizer for 1 yr retained a higher percentage of the metals which had been added. The differential solubilization of metals from the fertilizer appear to be one factor influencing metal retention on the plots although changes in sediment chemistry due to nutrient addition are also a factor. (Author's abstract)
W84-02129

ALUMINIUM CHEMISTRY AND ACIDIFICATION PROCESSES IN A SHALLOW PODZOL ON THE SWEDISH WESTCOAST,
Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard.
S. I. Nilsson, and B. Bergkvist.
Water, Air and Soil Pollution, Vol. 20, No. 3, p 311-329, October 1983. 3 Fig, 5 Tab, 43 Ref.

Descriptors: *Soil solution, *Aluminum, *Acidification, Leachates, Soil chemistry, Water pollution sources, Groundwater, Streams, Podzols, Organic aluminum, Inorganic aluminum, Leachates, Lake Gardsjon, Sweden.

Soil acidification and the solution chemistry of Al were studied in three adjacent small catchments at Lake Gardsjon, on the Swedish westcoast, with mixed coniferous forest and shallow podzols (average soil depth 50 cm). Soil solution from different depths, groundwater and streamwater were sampled. Separation of organic and inorganic Al species was done with an ion exchange technique. The concentration of organic Al species was linearly correlated with the concentration of dissolved organic C (r2 varied from 0.38 to 0.69 with $p < 0.001$). In the A horizon 83 to 97% of the dissolved Al consisted of organic species. The average concentration of total Al varied from 3.3 to 9.8 micromole/l m soil leachates collected below the Ao horizon, and from 29.3 to 47.0 micromole/l in leachates collected below the A2 horizon. The organic Al species decreased in importance with increasing soil depth. Leachates collected below the B horizon had average total Al concentrations ranging from 95.3 to 115 micromole/l, with a contribution of organic species varying between 8 and 20% of the total concentration. Activity calculations indicated an equilibrium with Al(OH)SO4 (pKs = 17.23) in the lower part of the B horizon, while groundwater together with some of the leachates from the upper B horizon showed a better fit with Al4(OH)10SO4 (pKs = 117.51). Streamwater was obviously influenced by the soil organic matter in the outflow areas in terms of Al - organic matter complexes and protolysis of dissolved organic acids. There was a net outflow of Al and sulfate from the lower part of the B horizon compared to input in throughfall precipitation. The relative concentration increase varied from 64.4 to 78.0 (Al) and from 1.52 to 1.92 (sulfate). The relative increase due to evapotranspiration was estimated to be 1.4. The corresponding concentration factors for Mg and Ca were from 2.06 to 2.38, and from 0.81 to 1.07, respectively, indicating a very low Ca weathering. The study is part of the Gardsjo project, which deals with the mechanisms for groundwater and lakewater acidification and the direct and indirect consequences of the latter for the lake biota. The Al mobility is a central question, as inorganic Al forms are detrimental to some fish species. (Moore-IVI)
W84-02133

COMPARATIVE STUDIES OF RADIONUCLIDES FROM GLOBAL FALLOUT AND LOCAL SOURCES IN GROUND LEVEL AIR AND SEWAGE SLUDGE,
Lund Univ. (Sweden). Dept. of Nuclear Physics.
B. Erlandsson, T. Ingemansson, and S. Mattsson.
Water, Air, and Soil Pollution, Vol. 20, No. 3, p 331-346, 1983. 12 Fig, 5 Tab, 12 Ref.

Descriptors: *Cobalt radioisotopes, *Nuclear powerplants, *Fallout, *Air pollution, *Storm wastewater, Water pollution sources, Path of pollutants, Wastewater treatment, Dry deposition, Beryllium radioisotopes, Sweden.

Sampling of both sludge and ground level air was carried out at Borgeby sewage treatment plant, located 5.8 km east of the Swedish nuclear power station at Barseback, which is situated on the west coast of southern Sweden. The sewage treatment plant serves about 14,000 people in two communities; the daily incoming water volume is about 4200 cu m, and about half the total wastewater is rainfall runoff. The measured time variation of the Co-60 concentration in sludge and ground level air was found to be in good agreement with the reported variation in release rate to the air from the power station when the prevalent wind direction is taken into account. The ratio between the Be-7 normalized concentration in sludge and ground level air was studied and was found to be about 1 for radionuclides due to global fallout but less than 0.002 for Co-60. The low value for Co-60 may be explained by assuming that this radionuclide is dry deposited on the ground and then washed off by rain. The idea of dry deposition is supported by the wash-off pattern for Co-60 by rain after a drought period. Results strongly support the hypothesis that Co-60 and other activation products are released to the air from nuclear power stations. (Moore-IVI)
W84-02134

ROLE FOR SEDIMENTS IN RETARDING THE ACIDIFICATION OF HEADWATER LAKES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
For primary bibliographic entry see Field 2H.
W84-02137

MERCURY POLLUTION OF FISHES IN MINAMATA BAY AND SURROUNDING WATER: ANALYSIS OF PATHWAY OF MERCURY,
Tokyo Univ. (Japan). Dept. of Chemical Engineering.
H. Nishimura, and M. Kumagai.
Water, Air, and Soil Pollution, Vol. 20, No. 4, p 401-411, November 1983. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Mercury, *Path of pollutants, *Fish, *Sediments, *Minamata Bay, Japan, Water pollution, Croaker, Zooplankton, Suspended solids, Particulate matter.

In 1973, an intensive survey of Hg pollution was made in Minamata Bay (Japan) and its surrounding water. Minamata Bay is estimated to have received about 260 t of Hg from an acetaldehyde plant which was in operation from 1932 through 1968. About 200 sediment samples and 1600 fish samples were collected for determination of Hg. The Hg level of a fish species and its local variation largely depended on the ecology of the species. The croaker was found to be a good indicator of Hg pollution of the sedentary fishes. The Hg level of a croaker showed a good correlation with the Hg level of sediment, but a better correlation was observed between the Hg content of croaker and that of zooplankton. A very close relationship was found between the Hg content of zooplankton and suspended particulate matter. A pathway of Hg from sediment to fish via suspended particulate matter and zooplankton was suggested. (Moore-IVI)
W84-02138

ACCUMULATION OF SELECTED TRACE METALS IN SOILS OF URBAN RUNOFF DETENTION BASINS,
Oklahoma State Univ., Stillwater. Dept. of Forestry.
P. J. Wigington, Jr., C. W. Randall, and T. J. Grizzard.
Water Resources Bulletin, Vol. 19, No. 5, p 709-718, October, 1983. 8 Fig, 5 Tab, 19 Ref.

Descriptors: *Trace metals, *Detention reservoirs, *Storm runoff, *Soil contamination, Urban runoff, Cadmium, Copper, Lead, Zinc, Washington, District of Columbia.

Field investigations were conducted at three sites in the Washington, D.C., area to detect accumulation patterns of the trace metals, cadmium, copper, lead, and zinc in the soils of urban stormwater detention basins. The research results seemed to indicate that the use of detention basins to control urban stormwater runoff had few harmful effects to fine textured soils with respect to the study trace metals. Although the trace metals, especially lead and zinc, were found to accumulate in the surface soils of the basins, little significant downward movement of metals in the soil profiles had occurred. Accumulations of metals in the surface soils appeared to be a function of microtopography and the resultant residence time of standing water. The fractions of trace metals that were present in a leachable form in surface soils and stormwater solids were small, with median values ranging from 7.7% of the total concentration for Cd to 0.01% for Pb. (Author's abstract)
W84-02158

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: I. A CHARACTERIZATION,
Vermont Univ., Burlington. School of Natural Resources.
For primary bibliographic entry see Field 2L.
W84-02164

QUALITY OF RUNOFF FROM MINNESOTA PEATLANDS: II. A METHOD FOR ASSESSING MINING IMPACTS,
Vermont Univ., Burlington. School of Natural Resources.
J. C. Clausen, and K. N. Brooks.
Water Resources Bulletin, Vol. 19, No. 5, p 769-772, October, 1983. 1 Fig, 2 Tab, 10 Ref.

Descriptors: *Peat, *Water pollution sources, *Peat mining, *Minnesota, Water temperature, Suspended sediments, Specific conductance, Acidity, Iron, Sodium, Nitrogen, Nonpoint pollution sources, Water quality.

The impacts of milled peat mining on runoff quality in northern Minnesota were determined using a multiple watershed approach. The milled peat mining operation requires clearing vegetation, ditching, raking, discing, and finally peat extraction with pneumatic harvesters. Coincident with sampling runoff quality from natural peatlands, samples were obtained from a ditch draining 155

ha of mined peatland. The frequency distributions of water quality constituents were used to detect whether runoff from a mined bog differed from that of 15 unmined (control) bogs. Peat mining increased water temperature, suspended sediment, specific conductance and concentrations of acidity, iron, sodium, and nitrogen species, although drinking water standards were not exceeded (alpha = 0.05). The multiple watershed method used enabled an evaluation of mining impacts without a long-term investment in streamflow monitoring. By incorporating several peatland watersheds into the study, a regional characterization of water quality constituents was obtained; comparisons between mined and unmined bogs were thus considered valid for the northern Minnesota region. (Moore-IVI)
W84-02165

SEDIMENT CHEMISTRY AS INFLUENCED BY VEGETATION AND BEDROCK IN THE SOUTHWESTERN UNITED STATES,
New Mexico Univ., Albuquerque. Dept. of Biology.
C. S. White, and J. R. Gosz.
Water Resources Bulletin, Vol. 19, No. 5, p 829-835, October, 1983. 5 Tab, 16 Ref.

Descriptors: *Sediments, *Vegetation, *Bedrock, Channel sediments, Sand, Silt, Clay, Organic matter, Minerals, Small watersheds.

It is hypothesized that sediment from small watersheds with uniform bedrock and a single vegetative community would have uniform chemical characteristics for the sand and fine (silt and clay) size fractions. Channel sediment was collected from three vegetative communities (spruce-fir, mixed conifer, and Ponderosa pine), each on four bedrock types (basalt, limestone, sandstone, and granite), and analyzed for digestable Ca, Mg, Na, K, Cu, Mn, Fe, Zn; total N and P; extractable Ca, Mg, K; cation exchange capacity; and organic matter. With the exception of organic matter content in the sand size fraction, either vegetation, bedrock, or their interaction were significant in explaining the observed variation for all analyses in both size fractions. Replicate studies of sites with similar bedrock and vegetation combinations are needed to determine if each watershed has similar or unique sediment chemistry. (Authop's abstract)
W84-02173

FACTORS AFFECTING THE CONCENTRATIONS OF CADMIUM, ZINC, COPPER AND LEAD IN THE SEDIMENTS OF THE VESDRE RIVER,
Liege Univ. (Belgium). Dept. of Botany.
C. Houba, J. Remacle, D. Dubois, and J. Thorez.
Water Research, Vol. 17, No. 10, p 1281-1286, 1983. 2 Fig, 5 Tab, 24 Ref.

Descriptors: *Sediments, *Heavy metals, *Vesdre River, Belgium, Zinc, Cadmium, Copper, Lead, Clay, Silt, Water pollution, Mining, Industrial wastes, Iron hydroxide, Phosphates.

The main factors influencing Cd, Zn, Cu and Pb concentrations in the sediments of the highly polluted Vesdre River (eastern Belgium) have been investigated. The concentrations of heavy metals in the tributaries were taken as a base reference. The reference levels are high due to past zinc mining activities in the area and the occurrence of zinc-enriched ores near the source of the river. The concentrations of the same elements are 5-10 times higher in the Vesdre, especially downstream from a former zinc factory. Only negative correlations were demonstrated between the clay content and heavy metals. The composition of the clay minerals could partially explain this paradox. The highest proportion of clay in the Vesdre is only 4% and it contains no smectite. The predominant clay component, illite, has a very low cation exchange capacity. Due to the small proportion of clay, the fraction of the sediment smaller than 14 microns is mainly composed of silt whose cation exchange capacity is negligible. The pretreatment of the minerals might influence the geochemical data obtained from analysis. Iron-hydroxides and phosphates seem to be the main sinks for Pb, Cd and Zn whereas organic components might play a less important role. (Moore-IVI)
W84-02180

TRANSPORT OF 14C-LABELLED PCB COMPOUNDS FROM SEDIMENT TO WATER AND FROM WATER TO AIR IN LABORATORY MODEL SYSTEMS,
Lund Univ. (Sweden). Limnological Inst.
P. Larsson.
Water Research, Vol. 17, No. 10, p 1317-1326, 1983. 10 Fig, 3 Tab, 34 Ref.

Descriptors: *Polychlorinated biphenyls, *Path of pollutants, *Sediments, Invertebrates, Pollutant transport, Model studies, Bubbles, Jet drops, Aquatic environment, Bioturbation, Bioaccumulation, Chironomids. Tubificids, Tetrachlorobiphenyl, Hexachlolobiphenyl, Octachlorobiphenyl.

Tetra-, hexa- and octachlorobiphenyls were added to aquatic model systems compound of undisturbed sediment cores with an overlying water phase. Using impactor plates transport of the compounds from sediment to air was observed. About one per cent of the sediment-bound PCBs recovered in the systems left the water by jet drops from bursting bubbles. The transport of PCBs from the sediment to the air was nearly constant over time, with a transport rate of 0.62 micro g/sq dm/week for tetrachlorobiphenyl. Tetrachlorobiphenyl was mobile in systems with and without macroinvertebrates and in those fixed with HgCl2. Hexa- and octachlorobiphenyls were transported from sediment to water mainly by bioturbation processes. The two latter substances had a higher adsorption to particles than tetrachlorobiphenyl. Compared to tetrachlorobiphenyl, more hexa- and octachlorobiphenyls accumulated in chironomids and tubificids. (Author's abstract)
W84-02183

ROTAVIRUS AND REOVIRUS STABILITY IN MICROORGANISM-FREE DISTILLED AND WASTEWATERS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
A. E. McDaniels, K. W. Cochran, J. J. Gannon, and G. W. Williams.
Water Research, Vol. 17, No. 10, p 1349-1353, 1983. 4 Fig, 2 Tab, 30 Ref. OWRT project B-054-MICH.

Descriptors: *Rotavirus, *Reovirus, *Virus survival, Distilled water, Wastewater, Water temperature, Infectivity, Viruses.

Survival of calf rotarvirus and reovirus under controlled laboratory conditions in microorganism-free, distilled and wastewater at 8 and 26 degrees C was examined by periodic measurement of cytopathic effects (CPE) and indirect fluorescent antibody (IFA) assays. Five samples of both water-types were collected and inoculated with the two viruses. Three samples of each type of water were divided into two bottles, one per virus, for incubation at 8 degrees C. Two samples were used at 26 degrees C one per trial. In the absence of light and shaking at 26 degrees C, 7-13 days were required for a loss of 90% infectivity for rotavirus and reovirus, while at 8 degrees C, averages were 80 days for rotavirus and 260 days for reovirus. Virus infectivity remained for more than 30 days at 26 degrees C and 400 days at 8 degrees C. Rates of decline were 10-100 times greater at 26 than at 8 degrees C, but at both temperatures, the MPN log 10 rate of decline of infectivity was linear. (Author's abstract)
W84-02184

SORPTION OF HYDROPHOBIC COMPOUNDS BY SEDIMENTS, SOILS, AND SUSPENDED SOLIDS - I; THEORY AND BACKGROUND,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
T. C. Voice, and W. J. Weber, Jr.
Water Research, Vol. 17, No. 10, p 1433-1441, 1983. 3 Fig, 59 Ref.

Descriptors: *Fate of pollutants, *Sorption, Soils, Suspended solids, Sediments, Hazardous wastes, Transport, Hydrophobic compounds, Organic carbon, Partition coefficient.

The current level of understanding of sorption processes relative to hydrophobic compounds in aquatic systems is reviewed. Particular emphasis is given to the details of sorption theory and to the extent to which it can be applied to the adsorption of hydrophobic pollutants by sediments, soils, and suspended solids. Hydrophobic bondng, an entropically driven dissolution reaction, is a major sorption mechanism. A universal sorption model has yet to be found and data must be treated on a case-by-case method. Total organic carbon content appears to be the major factor in determining a solid's sorptive potential. The octanol-water partition coefficient is the best known indicator of the extent to which a compound will sorb. Sorption reactions of hydrophobic compounds are generally rapid. (Baker-IVI)
W84-02194

SORPTION OF HYDROPHOBIC COMPOUNDS BY SEDIMENTS, SOILS AND SUSPENDED SOLIDS - II; SORBENT EVALUATION STUDIES,
W. J. Weber, Jr., T. C. Voice, M. Pirbazari, G. E. Hunt, and D. M. Ulanoff.
Water Research, Vol. 17, No. 10, p 1443-1452, 1983. 11 Fig, 2 Tab, 12 Ref.

Descriptors: *Fate of pollutants, *Sorption, Soils, Suspended solids, Sediments, Hazardous wastes, Transport, Hydrophobic compounds, Polychlorinated biphenyls, Microorganisms, Model studies, Partition coefficient.

Sorptive interactions of pollutants with sediments and suspended solids in natural aquatic systems were investigated. The interpretation of these data vis-a-vis published data for other systems suggests that certain conclusions particularly those drawn from pesticide/soil systems, can be extended to hydrophobic pollutants in aquatic environments. The organic carbon content of a solid appears to be the major factor in determining its sorptive capacity. Other properties of both the solid and the system in which it is dispersed, especially the concentration of a sorbing pollutant, are important as well. Assumptions of linear partitioning, commonly made in the descriptive modeling of sorption reactions in aquatic systems, should be used with extreme caution, and only after substantiation for the specific sorbate/sorbent combination and concentration range in question. The concentration of solids appears to affect linear partition coefficients in a manner consistent with the Freundlich model. Sorption reactions between hydrophobic pollutants and sediments or suspended solids in aqueous systems are rapid and probably not rate-limited. (Baker-IVI)
W84-02195

EFFECT OF SUBSOIL CONDUCTIVITY AND THICKNESS ON INTERFLOW PATHWAYS, RATES AND SOURCE AREAS FOR CHEMICALS IN A SLOPING LAYERED SOIL WITH SEEPAGE FACE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 2G.
W84-02208

CONCEPTUALIZATION OF A MODEL FOR THE MOVEMENT OF POLLUTION IN AN AQUIFER - APPLICATION TO THE RHINE GRABEN (CONCEPTION D'UN MODELE DE PROPAGATION DE POLLUTION EN NAPPE AQUIFERE - EXEMPLE D'APPLICATION A LA NAPPE DU RHIN),
Bureau de Recherches Geologiques et Minieres, Strasbourg (France). Service Geologique Regional Alsace.
P. Vigouroux, J. P. Vancon, and C. Drogue.
Journal of Hydrology, Vol. 64, No. 1/4, p 267-279, July, 1983. 5 Fig, 1 Tab, 5 Ref.

Descriptors: *Aquifers, *Fate of pollutants, Retention, Convection, Dispersion, Rhine Graben, France, Industrial wastes, Chlorides, Sulfates, Waste dumps, Leachates, Model studies.

A model is presented for the spreading of pollutants in aquifers, taking into account convection, dispersion and retention. This two-dimensional plane model uses values of concentrations averaged over a vertical axis; it is written in FORTRAN IV. It had been used to study some existing cases of pollution in the aquifer of the Rhine Graben, which is one of the most extensive in Europe (170 km x 30 km). The role of different parameters governing the spreading of pollution is described by the model. Over large distances, retention has a dominant influence. Dispersion mainly affects the displacement of concentration peaks over short distances, but becomes less important at greater distances from the source. The example considered refers to pollution by soluble salts (chlorides and sulfates) which were leached from industrial waste dumps. The hydrodynamic dispersion model has been verified for a period of about 30 years. The slight deviations between observations and model results are probably due to the effects of gravity, which were neglected in the model. The model shows also the effects of countermeasures which were taken to prevent future spreading of pollutants. (Baker-IVI)
W84-02212

QUALITY OF SEEPAGE AND LEACHATE FROM MINE AND MILL WASTES AND CONTROL OF ITS EFFECTS,
D. van Zyl, T. A. Shepherd, and A. C. S. Smith.
Transportation Research Records, No. 892, p 8-12, 1983. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Mine wastes, *Water pollution control, Detergents, Seepage, Highways, Construction, Leachates, Environmental effects, Acid mine drainage.

Mine and mill wastes, such as waste rock and tailings, are possible sources of road construction material. However, although such materials may be suitable from geotechnical considerations, they may prove to be problematic as they may produce contaminated seepage and leachate. A classification is presented of the types of mine and mill waste. Three important considerations in the use of these mine wastes are (a) the origin and characteristics of the waste rock; (b) the influence of mineral extraction process on leachate quality from tailings (typical problems associated with the various waste types are highlighted); and (c) changes in soil structure due to leachate, e.g., the Na ion, which can accelerate weathering or lead to changes due to ion exchange. Leachate from mine waste can have detrimental effects on the environmental due to effluent quality. It can also influence the integrity of engineering structures through chemical attack in many forms. The detrimental effects of leachate from mine waste can be controlled by treatment before placement, treatment during placement, treatment of effluent, and other methods, e.g., the use of detergents to inhibit bacterial activity in the formation of acid drainage. (Author's abstract)
W84-02217

SURVEY OF TECHNIQUES USED FOR PREDICTING LEACHATE QUALITY,
J. C. Wright, Jr., and S. S. Iyengar.
Transportation Research Record, No. 892, p 20-25, 1983. 4 Tab, 17 Ref.

Descriptors: *Leachates, *Testing procedures, Fate of pollutants, Acidity, Sulfur, Fill materials, Waste disposal.

Prediction of waste or fill leachate quality is often an important consideration, as it can be used in determining material placement, drainage designs, leachate containment (clay liner), or surrounding material interaction evaluations and identifying potential impacts to hydrologic regimes, ecological systems, or treatment requirements. In addition, leachate characteristics are often used to classify materials (e.g., hazardous wastes or acid-producing overburden or fill). There are several leachate evaluation test methods, which range from predicting the potential presence of selected characteristics within possible leachates to actual leachate quality determinations of representative materials by using representative leachate fluids. Because cost and time requirements vary with each leachate prediction test, the test method chosen to evaluate a material's potential leachate quality should be based on information requirements of the investigation. Several nonleaching, batch, and column leaching tests were examined as to information that can be obtained from these leachate prediction techniques. Several of these leachate quality prediction techniques, which included reaction pH, total sulfur, acid-base accounting, American Society of Testing and Materials 1:4 shake extraction of solid waste with water, U.S. Environmental Protection Agency extraction procedure toxicity test, and periodic column leaching tests, were then applied to several waste materials. The resulting test data were then compared. The application and usefulness of the various testing procedures in predicting leachate quality of inorganic parameters are discussed. (Author's abstract)
W84-02218

IDENTIFICATION OF SOURCE MATERIALS FOR ACID LEACHATES IN MARYLAND COASTAL PLAIN,
D. P. Wagner, D. S. Fanning, and J. E. Foss.
Transportation Research Record, No. 892, p 25-28, 1983. 3 Tab, 17 Ref.

Descriptors: *Leachates, *Coastal plains, Sulfuric acid, Acidity, Oxidation, Sediments, Pyrite, Chemical reactions, Maryland, Weathering, Minerals, Sulfates, Excavation, Construction.

The generation of excessive amounts of sulfuric acid often becomes a severe problem when excavation activities cause the exposure of sulfide-bearing rocks and sediments to the oxidizing atmosphere. Because of the hazards these sediments pose to building materials and ecosystems when exposed to the atmosphere by excavation, identification of sulfidic strata is an important first step in the course of construction activities to avoid or control acid sulfate problems. Acid leachates are produced in the oxidation of naturally occurring, sulfide-bearing sediments distributed throughout much of the Maryland Coastal Plain. Geologic ages for the sediments span from Lower Cretaceous through Tertiary. When these sediments are exposed to the atmosphere, sulfuric acid is produced in quantities sufficient to prohibit plant growth, dissolve concrete, and corrode metal. Initial pH values of near neutral or above may drop to as low as 2 after the sulfidic sediments undergo oxidation. In addition to pH, characteristics useful in identifying sulfide-bearing Coastal Plain sediments include sulfur content, sediment morphology, presence of sulfide or sulfate minerals, and morphology of surface soils formed from the sediments. Unoxidized sulfidic sediments are mostly dark colored. Typical colors include black (5Y 2.5/1), gray (10YR 5/1), or dark gray (5Y 2/1). Pyrite has been identified as the principal sulfide mineral present in the sediments. Pyrite morphology ranges from large megascopic crystals associated with Lower Cretaceous lignitic deposits to microscopic framboids common in Upper Cretaceous and Tertiary formations. Sulfate minerals formed from pyrite oxidation are useful field indicators of acid-generating sediments. Sulfate minerals that have been identified in acidic sediments include rozenite, szomolnokite, ferrohexahydrite, copiapite, gypsum, and jarosite. Jarosite is a highly persistent mineral and has often been observed in naturally weathershed soil profiles formed from sulfide-bearing sediments. The identification of jarosite in near-surface soil horizons thus may serve as an indication of underlying sediments with acid-generating potential. (Baker-IVI)
W84-02219

LEACHATES FROM EXCAVATIONS AND FILLS: SUMMATION,
J. G. Laguros, and L. W. Canter.
Transportation Research Record, Vol. 892, p 28-33, 1983. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Leachates, *Water pollution sources, Sediment transport, Sedimentation, Ammonia, Environmental effects, Groundwater pollution.

Five papers presented at the Symposium on Leachates from Highway Fills and Cuts are summarized. The papers deal with source characterization, leachate testing both in quality and in quantity and rate-determining factors, environmental transport, environmenttal effects and evaluation thereof, and control and abatement of leachates. Present data indicates that leachate quality and quantity is a problem of great concern. Although the undesirable effects of leachates on surface watercourses have been studied adequately, the data on groundwater quality are minimal. Sources of leachates have been well identified and there is continuing, if not increasing, interest in this area. However, leachage control data lag very much behind source data. Field oriented studies on a broad scale should be initiated to identify leachate control methods. The studies on rate-determining factors for nearly all phases of leachate effects appear to have not reached a level that offer dependable design values. (Baker-IVI)
W84-02220

MANAGEMENT OF DRAINAGE SYSTEMS FROM HIGHWAY BRIDGES FOR POLLUTION CONTROL,
Y. A. Yousef, M. P. Wanielista, H. H. Harper, and J. E. Christopher.
Transportation Research Record, No. 896, p 51-55, 1983. 2 Fig, 5 Tab, 11 Ref.

Descriptors: *Highway effects, *Bridges, *Runoff, Cadmium, Heavy metals, Lead, Zinc, Copper, Chromium, Iron, Nickel, Drains, Sediments, Floodplains, Drainage systems, Lake Ivanhoe, Orlando, Florida.

Pollutants associated with runoff water from highway bridges were characterized and quantified. These pollutants are directly discharged through scupper drains to adjacent water bodies and floodplains or detained in ponds before being released to lakes and streams. Selected heavy metals, such as lead, zinc, copper, chromium, iron, nickel, and cadmium, were of particular concern because of their potential enrichment in biota. Results show significant differences in heavy metal concentrations between water samples from bridge runoff and adjacent streams. Heavy metals tend to concentrate in bottom sediments, floodplains, and adjacent soils. For example, bottom sediment samples from Lake Ivanhoe, north of Orlando, Florida, collected beneath bridges with scupper drains showed significantly higher concentrations of heavy metals than did samples collected beneath bridges without scupper drains. In addition, concentration of heavy metals in the sediments of detention ponds receiving bridge drainage were higher than concentrations in sediments from adjacent lakes. It appears that management and careful design consideration of highway bridge drainage systems could result in significant reduction of the amount of pollutants released to adjacent water bodies. (Author's abstract)
W84-02227

VERIFYING THE EFFECT OF ACID PRECIPITATION ON SOIL LEACHATES: A COMPARISON BETWEEN PUBLISHED RECORDS AND MODEL PREDICTIONS,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
P. A. Arp, and S. Ramnarine.
Ecological Modelling, Vol. 19, No. 2, p 119-138, June, 1983. 1 Fig, 8 Tab, 19 Ref.

Descriptors: *Acid precipitation, *Soil chemistry, *Leaching, Model studies, Soil water, Groundwater, Water quality, Aluminum, Iron, Hydrogen ion concentration, Sodium, Potassium, Calcium, Magnesium, Cations.

A model for predicting the effects of acid precipitation on the acid ($H(+) + Al(3+) + Fe(3+)$)- and base ($Na(+) K(+) + Ca(2+) + Mg(2+)$)-cation losses from soil via leaching as function of

time was verified by examining published results for one indoor and five outdoor lysimeter studies (with precipitation pH-values ranging from 2 to 6), and five watershed studies. In each case the prediction of the model were in acceptable (but not perfect) agreement with the observed acid and base cation losses. These studies were selected from other relevant studies because they nearly met the information requirements of the model. The prediction of the acid cation content of soil leachates is important for considering the generally negative effects of such cations (especially the dominating Al(3+)-ions) on plant growth and ground-, stream- and later water quality. (Author's abstract)
W84-02238

MODELLING THE EFFECTS OF ACID PRECIPITATION ON SOIL LEACHATES: A SIMPLE APPROACH,
New Brunswick Univ., Fredericton. Dept. of Forest Resources.
P. A. Arp.
Ecological Modeling, Vol. 19, No. 2, p 105-117, June, 1983. 1 Fig, 17 Ref.

Descriptors: *Acid precipitation, *Soil chemistry, *Leaching, Acidification, Model studies, Water pollution sources, Hydrogen ion concentration, Iron, Aluminum, Sodium, Potassium, Magnesium, Calcium, Cations.

A model is proposed to provide a simple, yet quantitatively valid perspective for the extent of soil (and lake) acidification to be expected for chemically and biologically active soils under the threat of acid precipitation. The model attempts to predict the acid (H(+) + Al(3+) + Fe(3+)) and base (Na(+) + K(+) + Mg(2+) + Ca(2+)) cation losses from the soil, calculated from the rate and amount of acid cation retention when the rate of acid cation input is constant. It is assumed that the total amount of acidity retained by the soil is limited and qualitatively follows a Freundlich-type 'absorption' isotherm. Required input information for the model includes (i) the total amounts of acid and base cations received by the soil via precipitation and weathering (minus normal leaching losses), (ii) the exchangeable base cation content and total number of cation exchange sites of the soil prior to the onset of acid precipitation. (Author's abstract)
W84-02239

NITRIFICATION MODEL WITH AN INHIBITORY EFFECT OF SEA WATER,
Tokyo Univ. (Japan). Dept. of Urban and Sanitary Engineering.
For primary bibliographic entry see Field 2L.
W84-02241

TOXIC SUBSTANCE MONITORING IN THE INDIAN RIVER LAGOON, FLORIDA,
Harbor Branch Foundation, Inc., Fort Pierce, Florida.
For primary bibliographic entry see Field 5A.
W84-02251

TRACE METALS IN THE INDIAN RIVER LAGOON, FLORIDA: THE COPPER STORY,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
J. H. Trefry, M. Sadoughi, M. D. Sullivan, J. S. Steward, and S. Barber.
Florida Scientist, Vol. 46, No. 3/4, p 415-427, 1983. 6 Fig, 1 Tab, 19 Ref. Florida Sea Grant College grant 04-8-MO1-76.

Descriptors: *Copper, *Water pollution sources, *Indian River Lagoon, Florida, Eau Gallie Harbor, Indian River, Trace metals, Anti-fouling paint, Sediments, Barnacles, Clams, Crabs, Leaching, Fate of pollutants.

Inputs of copper from anti-fouling paints presently pose an environmental stress on some restricted embayments of the Indian River Lagoon, Florida. Over an 18 month period, samples of water, suspended matter, sediments, barnacles, clams and crabs from selected sites along the Indian River and the Eau Gallie River, have been analyzed for copper. Higher than normal copper concentrations were consistently observed in the water column, sediments, barnacles and crabs collected from the Eau Gallie Harbor. Point sources of copper could be directly traced to vessel-related activities. From field data and laboratory experiments on the leaching of copper from anti-fouling paints, an estimated flux of 40 kg/yr to Eau Gallie Harbor was calculated. Up to 75% of the total copper input to the harbor may be retained there. Outside such tributaries along the Indian River from Vero Beach to Melbourne, copper levels were within normal limits. (Author's abstract)
W84-02253

DISTRIBUTION OF ENTERIC VIRUSES AND MICROORGANISMS IN LONG-TERM SEWAGE-TREATED SOIL,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
Z. Filip, K. Seidel, and H. Dizer.
Water Science and Technology, Vol. 15, No. 5, p 129-135, 1983. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater irrigation, *Land disposal, *Microorganisms, *Enteroviruses, Groundwater pollution, Viruses, Soil contamination, Bacteria, Actinomycetes, West Berlin, West Germany.

To determine whether long-term sewage treatment can take place without a pollution risk for soil and groundwater, samples from sewage irrigation fields in West Berlin (West Germany) which have been in use since about 1890 were analyzed for enteric viruses and microorganisms. Enteric viruses were detected in only seven samples from a total number of eighty seven taken from different soil depths. With only one exception, no viruses were found below 60 cm. No viruses were detected in groundwater samples. Long-term sewage irrigation did not result in significant changes in the colony counts of aerobic soil bacteria, but the counts of anaerobic bacteria and actinomycetes were slightly elevated and those of microscopic fungi slightly decreased. Potentially pathogenic bacteria were not detected in soil below 90 cm. (Author's abstract)
W84-02264

POTENTIAL OFF-FLAVOUR COMPOUNDS FROM CHLOROBLEACHING OF PULP AND CHLORODISINFECTION OF WATER,
Jyvaskyla Univ. (Finland). Dept. of Chemistry.
J. Paasivirta, J. Knuutinen, J. Tarhanen, T. Kuokkanen, and K. Surma-Aho.
Water Science and Technology, Vol. 15, No. 6-7, p 97-104, 1983. 2 Fig, 1 Tab, 26 Ref.

Descriptors: *Bleaching wastes, *Chlorination, *Taste, Water pollution sources, Pulp wastes, Fish, Chlorinated hydrocarbons, Phenols, Anisols, Aldehydes, Ketones, Finland.

Persistent chlorinated organic acids, phenols, and neutral compounds formed in chlorination processes and discharged to the aquatic environment are one source of tainting of fish below pulp bleaching and water chlorodisinfection plants. Microbial metabolism of the chlorobleaching residues can produce additional off-flavor causing compounds. The model compound approach employed revealed the structures and amounts of pollutants formed and has made the interpretation and assay of individual organochlorine compounds in the environment possible. Tainting of fish near chlorination plants is frequently observed. Chlorinated phenols and anisoles (microbial metabolites of the former) are chlorination products which are known to have a strong odor and taste at very low concentrations. Other chlorinated products, which are potential tainting substances, e.g. halogenated hydrocarbons, acids, aldehydes and ketones were also studied. Contents of some organochlorine pollutants in pikes of Middle Finland were compared by the taste panel evaluation of the same fish samples. (Moore-IVI)
W84-02272

VOLATILE SUBSTANCES FROM ACTINOMYCETES: THEIR ROLE IN THE ODOR POLLUTION OF WATER,
Rutgers - The State Univ., Piscataway, NJ. Waksman Inst. of Microbiology.
N. N. Gerber.
Water Science and Technology, Vol. 15, No. 6-7, p 115-125, 1983. 10 Fig, 43 Ref.

Descriptors: *Odor control, *Actinomycetes, Organic compounds, Volatility, Water quality control, Geosmin, Methylisoborneol, Isopropylmethoxypyrazine.

The isolation, structure proof and chemical synthesis of three volatile, highly odorous metabolites of actinomycetes are presented as well as their relation to odor problems in natural waters. The three include geosmin, methylisoborneol and 2-isopropyl-3-methoxy pyrazine. Other volatile but less odorous metabolites of actinomycetes including mucidone are mentioned. The role of actinomycetes in the odor pollution of natural aters, fish and other items of commerce such as milk, cacao beans, tobacco and wine has been long known. Of the three major actinomycetic odorants studied the pyrazine has absorption in the UV range which means that it might be determined easily by high pressure liquid chromotography. The maxima are 275 nm at neutrality and 295 nm under slightly acid conditions. (Baker-IVI)
W84-02273

MEASURES TO PREVENT WATER POLLUTION BY CHEMICAL FERTILIZERS AND SOIL EROSION PRODUCTS,
P. S. Pasternak, N. N. Prikhod'ko, V. P. Landin, and Yu. D. Matukhno.
Water Resources, Vol. 9, No. 4, p 409-415, July-August, 1982. 6 Tab, 12 Ref. Translated from Vodnye Resursy, No. 4, p 128-135, July-August, 1982.

Descriptors: *Groundwater pollution, *Fertilizers, *Erosion control, Organic compounds, Urea, Ammonium nitrate, Superphosphate, Manure, Nitrophoska, Phosphorus, Potassium, Reforestation, Water pollution control.

Part of the fertilizers applied to croplands enters water bodies with the surface and subsurface runoff and affects the chemical composition and quality of natural waters. Modern agricultural techniques have become one of the greatest contributors of biogenic elements (BE) to the water system. A study of the effect of various forms and rates of chemical fertilizers on the quality of surface runoff from croplands was carried out in model experiments with sugar beets set up on runoff plots with fourfold replication. The most common fertilizers used were studied including ammonium nitrate, urea, granulated superphosphate, manure salts, and nitrophoska at rates of 60, 90, and 180 ka/ha of the active ingredient. Fertilizers were applied in the spring during topdressing of the crops. An additional 30 kg/ha each of phosphorus and potassium were applied on the plot in the autumn for fall plowing. It was established that the level of pollution of the runoff waters and soil erosion products depends on the type of crop being cultivated, method and time of applying the fertilizers, and the intensity of the development of the erosion process. Positive effects of shelterbelts and afforestation on the composition of the surface runoff entering from fields is confirmed by special investigations on experimental drainage basins with a different degree of afforestation and also on combined runoff plots. Runoff-purifying tree stands simultaneously perform water-regulating and erosion control functions and therefore when creating and siting them on drainage basins it is necessary to be guided by the recommendations developed for shelterbelts and plantings having water regulating and erosion control purposes. (Baker-IVI)
W84-02324

EVALUATION OF THE PROSPECTS OF USING NATURAL RADIOISOTOPES WHEN

STUDYING SURFACE WATER-SUPPLY SOURCES OF MOSCOW,
V. D. Vilenskii.
Water Resources, Vol. 9, No. 5, p 507-510, September-October, 1982. 2 Fig, 2 Tab. Translated from Vodnye Resursy, No. 5, p 72-76, September-October, 1982.

Descriptors: *Radioisotopes, *Heavy metals, *Fate of pollutants, Path of pollutants, Surface waters, Radioactive tracers, Moscow, USSR.

The fate of water polluting heavy metals on entering rivers, lakes and reservoirs with wastewaters and surface runoff is of great interest. To evaluate the possible effect on water quality, it is customary to distinguish several forms of transport of metals in rivers: available, less available, or practically unavailable under natural conditions. As a first approximation the behavior of each heavy metal is determined by the rate of passage from a dissolved state into suspended matter and rate of removal of suspended matter into the bottom sediments. Natural radioactive isotopes of the uranium and thorium series can be used for evaluating the temporal characteristics of these processes in surface water bodies and streams. The main requirement in selecting pairs of radioisotopes is that the parent isotope should have greater solubility. Another important requirement is that the radioactive half-life of the daughter radioisotope should make it possible on the basis of the deviation from radioactive equilibrium between daughter and parent isotopes to determine in a wide range and half life of heavy metals in water, which corresponds to the differences in the residence time of the water itself in individual stretches of rivers and reservoirs. Along with the use of natural radioisotopes for estimating the temporal characteristics of removal of radioisotopes from rivers and reservoirs, it is of interest to use certain natural radioisotopes as analogs of heavy metals arriving from a single source. The rather low concentration of radioisotopes in surface water supply sources of Moscow present a definite barrier preventing the wide use of natural radioisotopes for estimating the temporal characteristics of removal of heavy metals from water of reservoirs and rivers. (Baker-IVI)
W84-02328

RADIOISOTOPE INVESTIGATIONS OF PROCESSES OF TECHNOGENIC EFFECTS ON NATURAL WATERS,
A. E. Babinets, V. V. Gudzenko, and V. K. Yanchev.
Water Resources, Vol. 9, No. 561-566, September-October, 1982. 2 Fig, 4 Tab, 8 Ref. Translated from Vodnye Resursy, No. 5, p 158-163, September-October, 1982.

Descriptors: *Water pollution sources, *Radioisotopes, *Groundwater pollution, Radon, Radium, Uranium, Powerplants, Groundwater pollution, Waste dumps, Springs, Radioactive tracers, Plankton, Organic matter, Path of pollutants, USSR.

The use of natural radioactive isotopes makes it possible to trace the change in the composition of groundwaters and to estimate the mixing proportions and also the character and intensity of the interconnection of aquifers with one another and with surface waters. Radiogenic isotopes were used for estimating the seepage from the ash dump storage ponds of the Voroshilovgrad (USSR) regional power station. Similar works are being carried out in the region of sections of the ash dump of the Tripol'e regional power station located on alluvial sand deposits of the right-bank region of the Stugna River. Points of issue of springs with a higher content and anomalously low isotopic ratio of uranium were detected in the region of the ash dumps. Mixing of these waters with waters of the ash dumps leads to a decrease of the U-234/U-238 ratio in the infiltration flow reaching the Stugna River. A noticeable decrease of the radium concentration in water samples taken at negative temperatures in the river and ash dump is observed. The observed decrease of concentrations is apparently related to suppression of plankton, which is confirmed also by an increase of water transparency. Evidently a part of the radium migrates with organics. At present a network of observation wells is being drilled, by means of which the movement of the front of the waters infiltrating from the storage ponds is to be estimated. (Baker-IVI)
W84-02334

INCURSION OF ACID DEPOSITION INTO WESTERN NORTH AMERICA,
Battelle Pacific Northwest Labs, Richland, WA. Environmental Sciences Dept.
W. T. Hinds.
Environmental Conservation, Vol. 10, No. 1, p 53-58, 1983. 4 Fig, 28 Ref.

Descriptors: *Acid rain, *Reviews, Western North America, North America, Nitrogen oxide, Sulfur oxide, Oxides, Environmental effects, Snowmelt, Acid precipitation.

Acidification processes in western North America will probably increase in scope and visibility over the foreseeable future. Localized acidification seems more probable for the next few decades than does a generalized acidified deposition over the western States. At least part of current acid deposition downwind of urban areas is associated with automobile emissions. However, increases in coal combustion for power generation might be expected to increase sulfur dioxide concentrations, along with several related acidifying agents. Interactions of air pollutants with orographic precipitation and snowmelt may bring some areas to public attention much earlier than others, depending upon site-specific matters of climate, topography, soils, water-bodies, and biota. Lakes and streams on windward slopes facing large urban or industrial sources of sulfur and nitrogen oxides may be most seriously at risk. Avoiding acidification may be much easier than amelioration, mitigation, or regulation. This suggests that susceptible landscapes and ecosystems should be identified as soon as possible. Then concerned public and private institutions can agree on specific areas that need protection from acid deposition. (Baker-IVI)
W84-02366

LAKE ONTARIO SEDIMENTS AS INDICATORS OF THE NIAGARA RIVER AS A PRIMARY SOURCE OF CONTAMINANTS,
Canada Center for Inland Waters, Burlington, Ontario. Great Lakes Fisheries Research Branch.
R. L. Thomas.
Journal of Great Lakes Research, Vol. 9, No. 2, p 118-124, 1983. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Water pollution sources, *Lake sediments, *Lake Ontario, *Niagara River, Great Lakes, Mercury, Ecosystems, Vanadium, Cadmium, Chromium, Lead, Copper, Nickel, Polychlorinated biphenyls, Trace metals, Pesticides, Sediments, Water circulation.

A review of sediment data from Lake Ontario clearly identify the Niagara River as a major problem area with respect to contamination of the entire Lake ecosystem. The area subject to investigation was intensified in 1976 with the indication that the source of mirex to the Lake was from the Niagara River. The distribution of contaminants in the lake have indicated the net transport of sediment-bound materials which has assisted in the general understanding of the occurrence of contaminants at many trophic levels in the ecosystem. Mean concentrations of a number of elements in suspended solids centrifuged from the Niagara River in 1974 further indicated that the river is also a major source of chromium, cadmium, vanadium, and arsenic and a lesser though significant source of lead, copper, and nickel. The distribution of mercury along the southern shore of the lake indicates a source in the Niagara River moving in an anti-clockwise gyre into the Niagara Basin with a second more prominent flow along the south shore with dispersion into the Rochester Basin. This agrees with the current circulation of the lake and the probable dispersion patterns from the Niagara River. (Baker-IVI)
W84-02403

DISTRIBUTION OF MAJOR ELEMENTS AND METALS IN SEDIMENT CORES FROM THE WESTERN BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Environment Contaminants Div.
A. Mudroch.
Journal of Great Lakes Research, Vol. 9, No. 2, p 125-133, 1983. 12 Fig, 18 Ref.

Descriptors: *Niagara River, *Lake Ontario, *Sediments, *Minerals, *Heavy metals, Metals, Sediment transport, Path of pollutants, Mercury, Zinc, Lead, Chromium, Copper, Nickel, Calcite, Clay, Silt, Water pollution.

An investigation was made of the relationship between the changes in metal concentrations in sediments with the distance from the Niagara River mouth and the chemical and physical characteristics of the sediments. Sediment cores were obtained at nine sampling stations in the western basin of Lake Ontario. In addition, surface sediment was collected at three stations on the Niagara Bar. Minerals present at all stations were silica, feldspars, illite/muscovite, chlorite, kaolinite, and calcite. Dolomite was found at some sampling stations as grains of 2 to 63 micro m size. Significantly elevated concentrations of calcite (up to 20%) in the surface sediment (about 0 to 10 cm) at four sampling stations in the western basin and in the entire 25-cm sediment column at the Niagara River mouth indicated increased input of this mineral into Lake Ontario during the past 100 years. Furthermore, sediment concentration profiles of Zn, Pb, Cr, Cu, Ni, and especially Hg at all sampling stations indicated major transport of metals associated with the clay- and silt-size particles from the Niagara River into Lake Ontario (especially north-north-east and east of the river mouth). A significant decrease in Hg loading from the Niagara River during the past 20 years was also observed. Although smaller in magnitude, a similar decrease was found for Pb, Zn, Cr, Ni, and Cu loading. However, elevated Hg concentrations (up to 7 micro g/g above background values) existed in the surface 10 cm of sediment at eight sampling stations. (Author's abstract)
W84-02404

HISTORY OF LAKE ONTARIO CONTAMINATION FROM THE NIAGARA RIVER BY SEDIMENT RADIODATING AND CHLORINATED HYDROCARBON ANALYSIS,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
R. W. Durham, and B. G. Oliver.
Journal of Great Lakes Research, Vol. 9, No. 2, p 160-168, 1983. 7 Fig, 1 Tab, 32 Ref.

Descriptors: *Lake Ontario, *Niagara River, *Water pollution sources, *Chlorinated hydrocarbons, *Sediments, Radioisotope dating, Industrial wastes, Chlorobenzenes, Chlorotoluenes, Hexachlorobutadiene, Octachlorostyrene, Mirex, Polychlorinated biphenyls, History.

Contamination of Lake Ontario by persistent organic compounds began with the development of the chemical industry along the Niagara River. These compounds are discharged to the river where they are scavenged from the water column by sedimenting particulates which in turn settle out in depositional areas of Lake Ontario. Pb-210, Cs-137, and chlorinated hydrocarbon profiles of sediment cores taken about 3 km from the mouth of the Niagara River were determined. Age profiles of the sediments were constructed from the radionuclide measurements and used to determine historic trends of chlorinated hydrocarbon input to Lake Ontario. The historical record found in the sediments for chlorobenzenes, chlorotoluenes, hexachlorobutadiene, octachlorostyrene, mirex, and PCBs is in good agreement with known production and usage patterns of the chemicals. Pollution of Lake Ontario with chlorinated hydrocarbons from the Niagara River is still occurring, but the worst contamination of the lake occurred in the 1960s. (Author's abstract)
W84-02406

FATES OF ORGANIC COMPOUNDS FROM NIAGARA FALLS DUMPSITES IN LAKE ONTARIO,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Kaminsky, K. L. E. Kaiser, and R. A. Hites.
Journal of Great Lakes Research, Vol. 9, No. 2, p 183-189, 1983. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Fate of pollutants, *Lake Ontario, *Niagara River, *Water pollution sources, *Sediments, Pollutant identification, Chlorinated hydrocarbons, Waste disposal, Hydrocarbons, Industrial wastes, Chlorostyrenes, Taffy tar, Electrolysis.

Sediment samples from the western portion of Lake Ontario were analyzed for chlorinated organic compounds using gas chromatography and gas chromatographic mass spectrometry. Both electron impact and negative chemical ionization mass spectrometry were employed. Many of the chlorinated compounds previously found to be leaking into the Niagara River from waste disposal sites in the city of Niagara Falls were identified in the sediments of Lake Ontario. In particular, two unique chlorofluorinated compounds, dichloro(trifluoromethyl)benzophenone and dichloro(trifluoromethyl)-alpha, alpha-difluorodiphenylmethane, were found in the lake's sediment, showing that stable compounds introduced into the Niagara River accumulate to detectable levels 100 km away in Lake Ontario. There is a tendency for compounds entering the lake from the Niagara River to accumulate in the zones of high sedimentation in the southern portions of both the Niagara and Mississauga basins. Chlorinated styrenes as well as several highly chlorinated polycylic aromatic hydrocarbons were also found. They may originate from taffy tar, the residue resulting from the cleanup of chlorine gas produced by electrolysis of NaCl brine using graphite plates. (Moore-IVI)
W84-02408

VOLATILE HALOCARBON CONTAMINANTS IN THE NIAGARA RIVER AND IN LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
K. L. E. Kaiser, M. E. Comba, and H. Huneault.
Journal of Great Lakes Research, Vol. 9, No. 2, p 212-223, 1983. 9 Fig, 2 Tab, 19 Ref.

Descriptors: *Halogenated hydrocarbons, *Lake Ontario, *Niagara River, *Water pollution sources, Carbon disulfide, Freon 11, Methylene chloride, Chloroform, Bromodichloromethane, Tetrachloroethylene, Path of pollutants, Toronto, Hamilton, Ontario, Twelve Mile Creek, Eighteen Mile Creek, Oak Orchard Creek, Black River, Welland Canal.

Water samples from 95 stations in Lake Ontario and 16 stations in the lower Niagara River were analyzed for volatile halocarbons and carbon disulfide. The following contaminants were observed at many stations with their lake-wide means and standard deviations: trichlorofluoromethane (Freon 11), 249 + or - 882 ng/L; methylene chloride, 572 + or - 1,826 ng/L; chloroform, 18 + or - 92 ng/L; bromodichloromethane, 3 + or - 9 ng/L; and tetrachloroethylene, 9 + or - 65 ng/L. Eleven other compounds, including carbon disulfide, 1,1-dichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and tetrachloroethylene were observed at trace levels or absent at most stations. Six compounds were observed in virtually all Niagara River samples and were traceable into the lake. As apparent from the large relative standard deviations for the above, contaminant concentrations varied strongly between stations, indicating areas of contaminant sources. Both industrialized and urban areas, such as Toronto, Hamilton, and the Niagara River, as well as comparatively small tributaries, such as Twelve Mile, Eighteen Mile, and Oak Orchard Creeks, Black River, and the Welland Canal, appear to be sources for several of the observed contaminants. (Author's abstract)
W84-02411

STATISTICAL EVALUATION OF TRENDS IN THE WATER QUALITY OF THE NIAGARA RIVER,
National Water Research Inst., Burlington, Ontario. Aquatic Physics and Systems Div.
A. H. El-Shaarawi, S. R. Esterby, and K. W. Kuntz.
Journal of Great Lakes Research, Vol. 9, No. 2, p 234-240, 1983. 5 Fig, 2 Tab, 6 Ref.

Descriptors: *Niagara River, *Water quality, Hydrogen ion concentration, Alkalinity, Phosphorus, Nitrates, Water pollution, Seasonal variation.

Using water quality data collected at Niagara-on-the-Lake, Ontario between 1975 and 1980, pH, alkalinity, total phosphorus, and nitrate concentrations are examined for changes over time. Moving averages, Spearman's rank correlation coefficient and regression methods, which model the seasonal cycle, are used. The yearly seasonal cycle for pH changes in 1978 in such a way that the regression curve, assuming an effect due to the year, drops below that obtained assuming no year to year differences in 1979 and 1980, whereas it was above in 1975 to 1978. This indicates a downward trend in pH, which is supported by negative correlation coefficients for May, August, September, and October. Very similar observations for alkalinity also suggest an increase in concentration, particularly in July, August, and September. The regression approach for total phosphorus indicated no year to year changes. (Moore-IVI)
W84-02412

CHLORINATED ORGANIC CONTAMINANTS IN WATER AND SUSPENDED SEDIMENTS OF THE LOWER NIAGARA RIVER,
Inland Waters Directorate-Ontario Region, Burlington. Water Quality Branch.
K. W. Kuntz, and N. D. Warry.
Journal of Great Lakes Research, Vol. 9, No. 2, p 241-248, 1983. 1 Fig, 9 Tab, 12 Ref.

Descriptors: *Niagara River, *Suspended sediments, *Chlorinated hydrocarbons, *Polychlorinated biphenyls, *Water sampling, Lake Ontario, Ontario, Mirex, DDT, Lake Erie, Water pollution sources.

Suspended sediment and raw water samples have been collected and analyzed for organochlorines and PCBs from a fixed location in the lower Niagara River at Niagara-on-the-Lake (Ontario) approximately weekly since 1979. Eight of the 19 organochlorine compounds measured were detected in more than 50% of the water samples analyzed, while 11 of the 19 compounds were detected in more than 50% of the suspended sediments collected at Niagara-on-the-Lake. Of the 10 chlorobenzene isomers measured, the one with the greatest usage (1,4-dichloro) occurs in largest concentrations in the suspended sediments at Niagara-on-the-Lake. Other chlorobenzene isomers commonly occurring in suspended sediments are 1,2 and 1,3 dichloro, 1,2,4-trichloro, 1,2,3,4-tetrachloro, pentachloro, and hexachloro. All isomers of chlorobenzene occurred in more than 70% of the suspended sediment samples collected. Total loadings to Lake Ontario calculated from these data indicate that PCB loadings are about twice as high as previously reported, while mirex and total DDT have decreased slightly. Although concentrations of contaminants in suspended sediments are usually higher than those measured in water samples, they are responsible for only about 40% of the total loadings or PCBs, DDT, and HCB, and significantly less for other organochlorine contaminants. Therefore, the data indicate that, to estimate total contaminant loadings, the water fraction must be sampled. Lake Erie is not the major source of such organic contaminants as PCBs and chlorobenzenes because contaminant levels in Lake Erie bottom sediments are 10 times lower for PCBs and 20 times lower for chlorobenzenes than in Niagara-on-the-Lake suspended sediments. (Author's abstract)
W84-02413

STUDIES OF TRACE CONTAMINANTS, NUTRIENTS, AND BACTERIA LEVELS IN THE NIAGARA RIVER,
Ontario Ministry of the Environment, Toronto. Water Resources Branch.
P. B. Kauss.
Journal of Great Lakes Research, Vol. 9, No. 2, p 249-273, 1983. 11 Fig, 8 Tab, 34 Ref.

Descriptors: *Niagara River, *Water pollution sources, *Lake Ontario, *Ontario, *New York, Tonawanda Channel, Heavy metals, Phenols, Polychlorinated biphenyls, Organochlorine pesticides, Mirex, Bacteria, Monitoring, Nutrients, Spatial distribution, Temporal distribution.

Sediment and water quality of the Niagara River were investigated during 1979 and 1980 to determine spatial and temporal differences in the levels of trace contaminants (heavy metals, phenolics, PCBs, and organochlorine pesticides) as well as nutrients and bacteria. Data from these studies as well as recent biomonitoring studies indicate that the Niagara River continues to be a source of such contaminants as PCBs, BHCs, mirex, and heavy metals to Lake Ontario. The major source of the contaminants is the highly industrialized and urbanized Tonawanda Channel area in the upper section of the river. Although a substantial improvement in phenolics levels was noted in the river since earlier surveys in 1971, bacterial and phosphorus levels show no significant changes, particularly near the U.S. mainland shore of the Tonawanda Channel and near the Buffalo River mouth. (Author's abstract)
W84-02414

VOLATILE CONTAMINANTS IN THE WELLAND RIVER WATERSHED,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
K. L. E. Kaiser, and M. E. Comba.
Journal of Great Lakes Research, Vol. 9, No. 2, p 274-280, 1983. 1 Fig, 2 Tab, 11 Ref.

Descriptors: *Volatile compounds, *Water pollution sources, *Welland River, Ontario, Niagara River, Carbon disulfide, Methylene chloride, Chloroform, Industrial wastes, Dilution, Degradation, Volatilization.

Surveys of selected volatile contaminants in water of the Welland River, a tributary to the Niagara River, in 1980 and 1981 show high levels of carbon disulfide, methylene chloride, and chloroform immediately below two industrial outfalls. Downstream from these point sources, a rapid decline in the contaminant concentrations is noted due to dilution, degradation, and/or volatilization of the compounds. Although toxic effects of other components of these effluents have been observed, the concentrations of the volatile contaminants are several orders of magnitude lower than those at which acute toxic effects on biota are observed. (Author's abstract)
W84-02415

COMPARTMENTAL DISTRIBUTION OF ORGANOCHLORINE CONTAMINANTS IN THE NIAGARA RIVER AND THE WESTERN BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington, Ontario. Environmental Contaminants Div.
M. E. Fox, J. H. Carey, and B. G. Oliver.
Journal of Great Lakes Research, Vol. 9, No. 2, p 287-294, 1983. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Organochlorine compounds, *Niagara River, *Lake Ontario, Fate of pollutants, Benthic fauna, Suspended solids, Sediments, Bioaccumulation, Chlorobenzenes, Hexachlorobutadiene, Polychlorinated biphenyls, Trophic level, Partition coefficient.

Persistent organochlorine contaminants are present in the Niagara River because of past and present industrial activity in the area. In order to extend past studies of organochlorine contaminants in the river, the fate of some of these compounds when enter Lake Ontario and the aquatic food chain was examined. Ten chlorobenzenes (CB), hexachlorobutadiene (HCBD), and PCBs were measured in Niagara River water and suspended solids, and in western Lake Ontario sediments and benthic fauna. High levels of these contaminants were found on all fractions of the river suspended solids, but the

larger particles contained much higher concentrations than the smaller particles. A portion of the CBs, HCBD, and PCBs present in the lake sediments was available to benthic organisms. A trend toward greater bioaccumulation for compounds having higher octanol-water partition coefficients was observed at all trophic levels. The relative accumulation factor for the more lipophilic compounds increases in higher trophic levels. (Moore-IVI)
W84-02417

INFLUENCE OF THE NIAGARA RIVER ON CONTAMINANT BURDENS OF LAKE ONTARIO BIOTA,
Canada Centre for Inland Waters, Burlington, Ontario. Dept. of Fisheries and Oceans.
D. M. Whittle, and J. D. Fitzsimons.
Journal of Great Lakes Research, Vol. 9, No. 2, p 295-302, 1983. 3 Fig, 5 Tab, 20 Ref.

Descriptors: Lake Erie, *Lake Ontario, *Niagara River, *Aquatic animals, *Water pollution sources, Fish, Zooplankton, Invertebrates, Trace metals, Organic compounds, Food chains, Polychlorinated biphenyls, DDT, Mirex, Mercury, Fate of pollutants, Bioaccumulation, Sediment-water interfaces.

Top predator and forage fish species, netplankton (>153 micro m), zooplankton, and benthic macroinvertebrates from Lake Erie and Lake Ontario were analyzed for whole body levels of trace metals and organic contaminants. Comparison of contaminant concentrations in similar aquatic food chains from both lakes indicated that levels of PCB, DDT, mirex, and mercury are significantly greater ($P<0.05$) in the biota of Lake Ontario. The Niagara River, the single largest tributary to Lake Ontario, was confirmed as a major source of organic contaminants and trace metals. Organic contaminants are adsorbed to the particulate load of the river and dispersed throughout Lake Ontario by the circulating currents. There was no significant regional difference ($P<0.05$) in the degree of contaminant accumulation by the pelagic food chain of Lake Ontario. Conversely, both inorganic and organic contaminant levels in the demersal amphipod, Pontoporeia affinis, were significantly different ($P<0.05$) between the eastern and western basins of Lake Ontario. The uptake and concentration of contaminants at the sediment-water interface is suggested as a possible mechanism to explain this observed difference. (Author's abstract)
W84-02418

HISTORICAL RECORDS OF METAL POLLUTION IN SEDIMENTS OF TORONTO AND HAMILTON HARBOURS,
National Water Research Inst., Burlington, Ontario.
J. O. Nriagu, H. K. T. Wong, and W. J. Snodgrass.
Journal of Great Lakes Research, Vol. 9, No. 3, p 365-373, 1983. 4 Fig, 4 Tab, 25 Ref.

Descriptors: *Water pollution sources, *Sediments, *Metals, *Hamilton Harbor, *Toronto Harbor, Ontario, History, Effluents, Storm wastewater, Industrial wastes, Spoil disposal, Zinc, Iron, Copper, Manganese, Lead, Chromium, Lake Ontario.

The sediments of Hamilton and Toronto Harbors contain some of the oldest records of metal pollution in the Great Lakes basin. The fluxes of Cd, Cr, Cu, Ni, Pb, Zn, Fe, and Mn into the two harbors have been estimated from the analyses of core samples dated by the Pb-210 technique. The contrasting metal levels in the two harbor sediments are related to the differences in the disposal strategies of the dredged spoils and the sources of metal pollution in the harbors. Hamilton Bay functions as the receiving water for effluent from numerous industrial operations and for treated wastewaters and untreated storm sewer overflows. Direct municipal and industrial discharges into Toronto Harbor are in no way near those of Hamilton Bay. Prior to World War II, a significant fraction of the spoils from Hamilton and the associated shipping channels was dumped into the deeper waters of the bay. The dredged spoils from Toronto harbor and shipping lanes have been used in land reclamation programs or dumped well outside the harbor. The Zn and Fe concentrations of 5 to 8 mg/g and 10 to 13% dry wt. in Hamilton Harbor sediments, which are among the highest recorded in any harbor, can be related to effluent discharges from the large local iron and steel plants. Over 80% of the Cu, Zn, Mn, and Fe inputs into Hamilton Harbor come from industrial discharges. Municipal effluents account for 28% of the Cr, 23% of the Pb, 11% of the Cu, and only 1% of the Fe delivered annually into the harbor. An inventory of the sources and sinks of pollutant metals in Hamilton Bay shows a substantive export of the metals to Lake Ontario. (Moore-IVI)
W84-02423

PHYSICO-CHEMICAL MODEL OF TOXIC SUBSTANCES IN THE GREAT LAKES,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
R. V. Thomann, and D. M. Di Toro.
Journal of Great Lakes Research, Vol. 9, No. 4, p 474-496, 1983. 11 Fig, 4 Tab, 54 Ref. EPA cooperative agreements CR805916 and CR807853.

Descriptors: *Physicochemical properties, *Lakes, *Fate of pollutants, *Great Lakes, Polychlorinated biphenyls, Particulate matter, Sorption, Desorption, Sediment-water interfaces, Suspended solids, Plutonium, Model studies.

Mass balance principles, incorporating principal mechanisms of particulate sorption-desorption, sediment-water and atmosphere-water interactions, and chemical and biochemical decay were used to construct a physico-chemical model of the fate of toxic substances in the Great Lakes. Solids flux balance calculations are not sufficient to determine the presence or absence of any sustained sediment resuspension effects since only net losses to the sediment can be estimated from solids budget computations. For time variable toxic fate modeling, it is necessary to determine the solids concentration in the water column which, for the open waters of the Great Lakes, is subject to some variability principally due to a lack of reliable data on open lake suspended solids. If the suspended solids in the Lakes are higher than used herein (0.5 mg/L for the upper lakes and Lake Ontario), then the net loss rate is less and resulting resuspension velocities increase. This will tend to decrease the response times of the lakes to reduction in external loads. Results of the application of the model to PCB levels in the Great Lakes indicate that the estimated upper range of present PCB loadings (from 4,080/yr for Lake Ontario to 9,500 kg/yr for Lake Superior) without volatilization is probably too high; from the available data it is not possible at the present time to distinguish the appropriate combination of loading and loss due to volatilization; and the response times due to load reduction of PCB may vary by an order of magnitude depending on the magnitude of the volatilization exchange rate - 50% response times vary from a few years with volatilization to 5 to 10 years or longer without volatilization. Comparison of these response times to observed declines in concentrations of PCB for Lake Michigan bloaters indicates that volatilization of PCB is occurring at an exchange rate of about 0.1 m/d at least for that lake. (Baker-IVI)
W84-02431

ANALYSIS OF POLYCHLORINATED BIPHENYL (PCB) LOADING TRENDS IN LAKE MICHIGAN,
Limno-Tech., Inc., Ann Arbor, MI.
P. W. Rodgers, and W. R. Swain.
Journal of Great Lakes Research, Vol. 9, No. 4, p 548-558, 1983. 3 Fig, 4 Tab, 38 Ref.

Descriptors: *Polychlorinated biphenyls, *Fish, *Lake Michigan, Great Lakes, Mathematical models, Public health, Chubs, Water pollution, Pollution load.

An historical loading trend for polychlorinated biphenyls was inferred using PCB concentrations in coregonid fishes collected from Lake Michigan between 1972 and 1980. The dynamics of PCBs are described using a mass balance model assuming that historical fish concentrations are proportional to concurrent water column concentrations of PCB. PCB loading during this period to the lake is described by a linearly decreasing trend. The calibrated model also forecasts the response of selected fish species to various loading scenarios. Forecast results indicate that a continuously decreasing load will result in compliance with US and Canadian guideline levels for human consumption. The availability of precise measurements of water : fish distribution coefficients will improve the accuracy of the predictions. (Baker-IVI)
W84-02436

OBSERVATIONS ON THE TIME OF TRAVEL OF WAVES IN THE RIVER SKERNE, ENGLAND, AND THE EFFECT OF AQUATIC VEGETATION,
Plymouth Polytechnic (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W84-02472

NITRATE TRENDS IN THE COASTAL PLAIN AQUIFER OF ISRAEL,
Israel Water Commission, Tel Aviv. Water Pollution Control Unit.
Y. Kanfi, D. Ronen, and M. Magaritz.
Journal of Hydrology, Vol. 66, No. 1-4, p 331-341, October, 1983. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Nitrates, *Coastal aquifers, *Israel, Mineralization, Water pollution sources, Groundwater pollution.

The variation in the average concentration of nitrates in the Coastal Plain aquifer of Israel was determined. Sampling was performed on 932 pumping wells which were distributed throughout the aquifer, comprising 60% of all the pumping wells in the aquifer. Sampling was done in the summer of 1973 and again in the summer of 1981. In 1973 the average nitrate concentration was 52 mg/l, which increased at a rate of 0.13 mg/l/year. The rates of increase of the average nitrate concentration were 1.45 mg/l/year in the 1950s and 0.56 mg/l/year during the 1960s. There is some evidence which indicates that the rate of nitrate concentration was even higher for the period 1920-1950. The initial high rates of nitrate increase were probably due to mineralization of about 400 kg N per 1000 sq m released when cultivation of virgin soils in the Coastal Plain began during the first half of this century. The reduction in the rate of nitrate increase indicates that the nitrogen system in the aquifer may be approaching a new steady state. (Baker-IVI)
W84-02475

5C. Effects Of Pollution

ORGANOCHLORINE RESIDUES IN BROOK TROUT FROM REMOTE LAKES IN THE NORTHEASTERN UNITED STATES,
Maine Cooperative Fishery Research Unit, Orono.
T. A. Haines.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 47-54, July 1983. 1 Fig, 4 Tab, 18 Ref.

Descriptors: *Trout, *Pesticide residues, *Organochlorine pesticides, Acid precipitation, Water pollution sources, Regression analysis, Water chemistry, Maine, New Hampshire, Vermont, Air pollution, DDE, Polychlorinated biphenyls.

Organochlorine residues were analyzed in brook trout (Salvelinus fontinalis) collected from six undistributed lakes in Maine, New Hampshire and Vermont. The residues (whole body) were compared among age groups of fish and were correlated by regression analyses with water chemistry factors that might be affected by acid precipitation. There were significant differences in the organochlorine content of fish from different lakes but not among age groups of fish within each lake or among all lakes. There were no significant correlations between the water chemistry values measured and organochlorine content of the fish. Inasmuch as no organochlorine pesticides have been

used within the lake watersheds, the compounds must have reached these lakes by atmospheric transport. (Author's abstract)
W84-02126

EFFECT OF VEGETABLE OIL FACTORY EFFLUENT ON OVARIAN RECRUDESCENCE IN THE FRESH WATER TELEOST, CHANNA PUNCTATUS (BL.),
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
P. K. Saxena, and R. Bhatia.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 55-61, July 1983. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Food-processing wastes, *Reproduction, *Channa punctatus, *Toxicity, Fish, Water pollution effects, Effluents, Vegetable oil wastes, Ovaries.

The effect of chronic exposure to a sublethal concentration (5%) of vegetable oil factory effluent on ovarian maturation of Channa punctatus was studied. The ovarian weights in effluent-exposed and control groups did not vary significantly up to 60 days of exposure. After 90 days of exposure, the ovarian weights in the effluent-exposed group were lower than in the control group, and this continued until the termination of the experiment at 120 days. After 60 days of exposure, the percentage of stage II oocytes was lower, while that of atretic oocytes was higher in the ovaries of effluent exposed fish. At 120 days of exposure, the percentage occurrences of stage II and atretic oocytes were higher in the exposed fish, while the percentage occurrence of stage III oocytes was higher in the control fish. This suggests that effluent exposure not only retarded the formation of stage III oocytes, but also caused higher incidence of atresia. (Moore-IVI)
W84-02127

CLINICAL APPROACH TO STUDY THE POLLUTANTS INTOXICATION IN A FRESHWATER TELEOST CLARIAS BATRACHUS,
Punjab Agricultural Univ., Ludhiana (India). Dept. of Zoology.
S. S. Dhillon, and A. K. Gupta.
Water, Air and Soil Pollution, Vol. 20, No. 1, p 63-68, July 1983. 3 Tab, 16 Ref.

Descriptors: *Aldrin, *Swascofix, *Toxicity, *Clarias batrachus, *Blood, Fish, Organochlorine pesticides, Detergents.

The effect of sublethal concentrations of aldrin (an organochlorine pesticide) and Swascofix CD-38 (an anionic detergent) on certain hematological parameters of C. batrachus was studied after 10, 20, and 30 day exposures. The parameters studied were clotting time, prothrombin time, hemoglobin, red blood cells, white blood cells, packed cell volume, mean cell hemoglobin, mean cell hemoglobin concentration, mean cell volume, specific gravity and pH. Clotting time, mean cell hemoglobin, and mean cell volume were found to decrease with increasing pollutant concentrations and time of exposure, while all other parameters showed an increase. However, pH and specific gravity remained generally unaffected. The increase in packed cell volume and hemoglobin can be attributed to the catalyzing action of aldrin and Swascofix CD-38 due to which the body iron stores are incorporated into hemoglobin. (Moore-IVI)
W84-02128

EFFECT OF MERCURIC CHLORIDE ON ELECTRON TRANSPORT SYSTEM (ETS) ACTIVITY IN SEDIMENT,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Water, Air and Soil Pollution, Vol. 20, No. 3, p 265-271, October 1983. 4 Tab, 15 Ref.

Descriptors: *Mercuric chloride, *Electron transport system, *Sediments, Microorganisms, Enzymes, Anaerobic conditions, Aerobic conditions.

The effect of mercuric chloride (HgCl2) on electron transport system (ETS) activity in sediment was studied using the reduction of 2-(p-iodophenyl)-3-(p-nitrophenyl)-5-phenyl tetrazolium chloride (INT) to water insoluble iodonitrotetrazolium formazan (INT-formazan) by respiring microorganisms and sediment enzymes. The effect of HgCl2 on ETS activity was more pronounced in aerobically incubated sediment than in anaerobically incubated sediment. The EC50 value for the inhibition of ETS activity in aerobically incubated sediment at 10 and 20 degrees C was 40.9 + or - 16.2 and 48.8 + or - 4.1 micro g/g HgCl2, respectively. The EC50 value for anaerobically incubated sediment in the presence of HgCl, at 4, 10, 20 degrees C was 153.0 + or - 8.1, 173.1 + or - 8.2, and 199.1 + or 15.2 micro g/g HgCl2, respectively. (Author's abstract)
W84-02131

INCIDENCE OF PLASMID-LINKED ANTIBIOTIC-HEAVY METAL RESISTANT ENTERICS IN WATER-SEDIMENT FROM AGRICULTURAL AND HARBOR SITES,
Vermont Univ., Burlington. Dept. of Microbiology and Biochemistry.
J. A. Mietz, and R. E. Sjogren.
Water, Air, and Soil Pollution, Vol. 20, No. 2, p 147-159, August 1983. 9 Tab, 28 Ref.

Descriptors: *Antibiotics, *Heavy metals, *Enteric bacteria, *Harbors, *Agricultural runoff, *Plasmids, Water pollution effects, Antibiotic resistance, Sediments, Ampicillin, Bacterial transformation, Lead, Zinc, Cobalt, Tellurium, Mercury, Drug resistance.

This study assesses the impact of antibiotics used in clinical and veterinary practices on the incidence of antibiotic-heavy metal resistant enterics in fresh water and sediment from agricultural and harbor sample sites. A total of 848 bacterial strains of the family Enterobacteriaceae was isolated from agricultural and lake harbor samples and identified to genus level. These were examined for antibiotic - heavy metal resistance. A select smaller number of these isolates were also examined for the presence of plasmids and ability to transfer antibiotic resistance via conjugation or transformation. More than 85% of the 848 isolates from all four sites were resistant to Pb, Zn, and Co while 5.6% to 16% were resistant to Te and 2.4% to 5.7% to Hg. The ranking of metal resistance according to frequency was the same as the frequency of metal occurrence in sediment samples. Of the total isolates tested, 87% were resistant to six or more antibiotics and 74% were also simultaneously resistant to Co, Zn, and Pb. Testing the resistance of the water isolates to antibiotics used solely in animal husbandry-veterinary medicine indicated that 55.6% of the agricultural isolates possessed resistance to these antibiotics while only 31.9% of the isolates from harbor water showed resistance to the same antibiotics. Of 41 ampicillin resistant isolates examined, 16(39%) were capable of transferring antibiotic - heavy metal resistance markers via conjugation. From this same group, plasmid DNA preparations were made. Of these latter preparations, 67% transformed recipient E. coli cells while 58% possessed discernible, often multiple plasmids when examined by gel electrophoresis. (Author's abstract)
W84-02135

VENTILATORY RESPONSES OF BLUEGILL SUNFISH TO SUBLETHAL, FLUCTUATING EXPOSURES TO HEAVY METALS (ZN(++) AND CU(++)),
Mississippi Univ., University. Dept. of Biology.
K. W. Thompson, A. C. Hendricks, G. L. Nunn, and J. Cairns, Jr.
Water Resources Bulletin, Vol. 19, No. 5, p 719-727, October, 1983. 6 Fig, 5 Tab, 24 Ref. EPA grant R80 52 740 10.

Descriptors: *Bluegill, *Bioindicators, *Toxicity, Heavy metals, Ventilatory response, Copper, Zinc, Environmental quality.

Minicomputer interfaced, continuous, noncontact sensing of the ventilatory behavior of the bluegill (Lepomis macrochirus) was used to investigate the response to exposure to solutions of copper and zinc under various modes of application. Fish respond to sublethal concentrations of these toxicants by increasing the average ventilatory rate as well as decreasing the amplitude of the ventilatory signal. The comparison of ventilatory data between individuals by conventional parametric methods is statistically valid. The use of sublethal doses of copper and zinc are detectable using the ventilatory response. The use of the ventilatory amplitude is a valuable supplement to the rate for the purpose of monitoring the quality of the aquatic environment. The three application patterns chosen for this study connot be statistically differentiated by the methods used in this analysis. (Moore-IVI)
W84-02159

LIMNOLOGY OF LAKE WABUKAYNE, A STORM-WATER IMPOUNDMENT,
Environmental Council of Alberta, Edmonton.
For primary bibliographic entry see Field 2H.
W84-02172

TOXICITY OF JET FUELS TO FISH - II; THE TOXICITY OF JP-8 TO FLAGFISH (JORDANELLA FLORIDAE) AND RAINBOW TROUT (SALMO GAIRDNERI) AND GOLDEN SHINERS (NOTEMIGONUS CHYSOLEUCAS),
California Univ., Richmond. Sanitary Engineering and Environmental Health Research Lab.
S. A. Klein, and D. Jenkins.
Water Research, Vol. 17, No. 10 p 1213-1220, 1983. 9 Fig, 6 Tab, 6 Ref.

Descriptors: *Fuel, *Water pollution effects, *Toxicity, *Trout, *Flagfish, *Shiners, Water soluble fraction, Bioassay, Growth, Hatching, Mortality, Bioaccumulation, Depuration, JP-8.

JP-8 is a widely-used commercial and military jet fuel which may reach the aquatic environment by several avenues. JP-8 is a kerosene-based aviation fuel which consists of a complex mixture of aliphatic and aromatic hydrocarbons and is similar to the commercial aviation fuel Jet A-1. The major difference is that JP-8 contains ethylene glycol monomethyl ether. The toxicity of JP-8 to cold and warm water fish was investigated to help define the impact on fresh water species. Fish were exposed to the water soluble fraction (WSF) of JP-8 in static acute bioassays and continuous-flow bioassays of approximately 4 months duration. The goal was to determine the 96-h LC50 and the long-term no effect level on the life cycle. The acute toxicity to golden shiner, a warm water fish, was found to be unaffected by pH in the range of 7.3-9.1. Flagfish growth was not affected by the presence of 1.7 mg/l WSF of JP-8, but the no effect level on rainbow trout was < 1.4 mg/l (the lowest level tested). Neither lethality nor egg hatching was a conclusive indicator of species sensitivity to the WSF of JP-8. Accumulation of fuel in tissues does not explain the greater toxicity of WSF of JP-8 to rainbow trout over its toxicity to flagfish. The accumulation ratio in flagfish is double that of trout. Depuration from flagfish is fairly rapid (90% in 14 days). Accumulation of JP-8 in fish tissue occurred at all aqueous fuel concentrations tested, so the presence of even very low levels of fuel in a body of water would cause off tastes and flavors in fish. (Moore-IVI)
W84-02175

PRELIMINARY STUDIES ON THE USE OF THE HETEROTROPHIC ACTIVITY METHOD TO EVALUATE ACID-STRESS EFFECTS IN AQUATIC ENVIRONMENTS,
Laurentian Univ., Sudbury (Ontario). Dept. of Biology.
G. D. Ferroni, L. G. Leduc, and C. G. Choquet.
Water Research, Vol. 17, No. 10, p 1379-1384, 1983. 6 Fig, 2 Tab, 18 Ref.

Descriptors: *Acid stress, *Acid lakes, *Acid rain, *Heterotrophic activity method, Phytoplankton, Ice cover, Glucose mineralization, Hydrogen ion concentration, Heavy metals, Aquatic environment, Silver Lake, Bethel Lake, Ontario.

The heterotrophic activity method was used to study the effects of acidification on mineralization activity in a lake in which acid rain is simulated (Bethel Lake), and in an acid-stressed lake (Silver Lake). In the fall, the rates of glucose mineralization by the planktonic microflora of Bethel Lake followed Michaelis-Menten kinetics at the in situ pH (7.5) and at the two experimental pH's (5.5 and 5.0). Turnover times for glucose increased with decreasing pH and, correspondingly, V max values decreased with decreasing pH. During ice-cover, only the in situ pH (6.85) gave a Michaelis-Menten response for glucose mineralization. At the experimental pH's, glucose mineralization activity was negligible. Analyses for soluble copper and nickel, the most important heavy metals in this environment with respect to concentration, indicated that the reduced glucose mineralization rates were not the result of acidification increasing the heavy metal concentrations (and, therefore, their toxicity). For the acid-stressed Silver Lake, glucose mineralization was negligible at the in situ pH (4.3) and at the experimental pH's (5.5 and 7.0) as well. The heterotrophic activity method is very useful in simulated acid rain studies on the aquatic environment, and it has considerable potential in the investigation of decomposition activities in acid-stressed lakes. Many of the lakes of interest are not acid stressed to the same degree as Silver Lake, and would mineralize substrates such as glucose at measurable rates and give the typical Michaelis-Menten response. (Moore-IVI)
W84-02188

EFFECT OF SANITATION EFFORTS ON THE MANGANESE CYCLE IN LAKE CONSTANCE (OBERSEE AND UNTERSEE-GNADENSEE) (DIE AUSWIRKUNGEN VON SANIERUNG-MASSNAHMEN AUF DEN MANGANHAUSHALT DES BODENSEES (OBERSEE UND UNTERSEE-GNADENSEE)),
Landesansalt fur Umweltschutz Baden-Wuettemberg, Langenargen (Germany, F.R.). Inst. fur Seenforschung und Fishereiwesen.
H. Rossknecht.
Archiv fur Hydrobiologie, Vol. 97, No. 3, p 346-355, July, 1983. 4 Fig, 11 Ref.

Descriptors: *Lakes, *Phosphorus, *Manganese, *Wastewater treatment, Oxygen, Sediment loading, Organic matter, Agriculture, Lake Constance.

Intensive purification measures were carried out in the catchment area of Lake Constance during the last 6 to 7 years. Prior to any attempted improvements, increased inputs of organic matter after the start of the farming period with the resulting reduction processes in the sediment-water layer brought about a remobilization of Mn(II) in the Obersee in July. This Mn(II) was immediately oxidized to Mn(III/IV) probably catalyzed by manganese bacteria, Metallogenium, the concentration of which showed a parallel course to those of Mn(III/IV). The Mn(II) values therefore remained generally below 1 microgram/liter. No oxygen could be detected for weeks in the hypolimnic waters of the Gnadensee during the summer. The manganese equilibrium was therefore shifted to the dissolved Mn(II) in 1978 and 1979. In the following two years an unexpected increase in oxidation of Mn(II) was noted. This indicated a gradual change in the redox situation of the Gnadensee. The coincidence of this change with the completion of sewage treatment plants is viewed as a first indication of the efficiency of these new purification measures. (Baker-IVI)
W84-02242

INFLUENCE OF ANTHROPOGENIC EUTROPHICATION: EFFECTS ON FISH IN THE FORM OF BLUE-GREEN ALGAE MASS DEVELOPMENT,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. Ya. Malyarevskaya.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 417-424, August, 1983. 5 Tab, 5 Ref.

Descriptors: *Eutrophication, *Fish, *Cyanophyta, *Toxicity, Water pollution effects, Algal toxins, Metabolism.

The influence of eutrophication after-effects on fish in the form of blue-green algae depends on a complicated system of biotic and abiotic factors. The effect is manifested in disturbances of plastic and energy metabolism ratios in fish in favor of the dominance of the latter, resulting from the disturbance of regulators of cellular metabolism and in particular of the cellular metabolism of nicotinamide coferments and coferment vitamins. Nitrogen consumption by fish exposed to the algae decreased and the majority of it was used for energy processes. When fish were treated with lethal amounts of blue-green algae, metabolic changes were even greater. The nitrogen balance of these fish was negative, and respiration was intensified. Lethal amounts of the blue-green resulted in increases of some of the free amino acids but a reduction in protein hydrolysate. These changes caused disturbances in protein synthesis and suppression of plastic metabolism. The mechanism of blue-green algae impact on fish can be described as follows: biologically active substances, excreted by the blue-greens in the process of metabolism and degradation (in particular, toxins) under conditions of increased permeability of fish cells penetrate into cells and alter the ionic ratio. The redox ratio of nicotinamide coferments shifts in prevalence of restored forms which intensify glycolytic processes and directs carbohydrate degradation to the anaerobic. The changes ultimately affect the Krebs cycle and respiratory chain and the pentose phosphate shunt in tissues where they are present. (Baker-IVI)
W84-02243

ACUTE TOXICITY OF PISCICIDE ANTIMYCIN-A, MOLLUSCICIDE BAYER-73 AND LAMPRICIDE-3 TRIFLUOROMETHYL-4-NITROPHENOL (TFM) TO THE SNAIL VIVIPARUS BENGALENSIS L.,
K.L.D.A.V. Coll., Roorkee (India). Dept of Zoology.
P. K. Gupta, and V. S. Durve.
Archiv fur Hydrobiologie, Vol. 97, No. 4, p 540-550, August, 1983. 8 Tab, 40 Ref.

Descriptors: *Snails, *Toxicity, *Pesticides, Bioassay, Antimycin-A, Bayer-73, TFM, Molluscides, Piscicides, Lampricides.

For acute-toxicity tests, a freshwater snail Viviparus bengalensis L. was exposed to a piscicide (Antimycin A), a molluscicide (Bayer 73) and a lampricide (3-trifluoromethyl-4-nitrophenol (TFM)). Static bioassay method was adopted for the evaluation of the toxicity of these chemicals. The lethal concentrations (LC16, LC50 and 95% fiducial limits and LC84), slope functions regression equations, heterogeneity factors, median, survival periods, analysis of variance, presumable harmless concentrations and relative potencies of the three toxicants were worked out for 12, 24, 48, 72 and 96 hr exposures. The rank order toxicity among the three toxicants was Antimycin A > Bayer 73 > TFM. Bayer-73 was more toxic than Antimycin A up nto 48 hr exposure. Beyond this period, its toxicity decreased and Antimycin A was found to be most toxic. Based upon the 96 hr LC50, Bayer-73 was 8.45 and TFM 764.83 times less toxic than Bayer-73. (Moore-IVI)
W84-02247

OCCURRENCE OF A TOXIC DINOFLAGELLATE IN THE INDIAN RIVER SYSTEM,
Florida Inst. of Tech., Melbourne. Dept. of Oceanography and Ocean Engineering.
D. R. Norris.
Florida Scientist, Vol. 46, No. 3/4, p 150-153, 1983. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Dinoflagellates, *Indian River, *Banana River, *Florida, Gonyaulax, Fishkill, Red tide, Hypnozygotes, Lagoons.

A compilation is presented of published and unpublished references to Gonyaulax monilata in the Banana and Indian Rivers (Florida) along with the available hydrographic data and maximum cell concentrations. There were only two references to fish kills but even then there was not enough evidence to implicate G. monilata as the direct cause. The fish kills could have been due to oxygen depletion. The apparent lack of motile cells for months, if not years, in a given location supports the belief that benthic resting cysts or hypnozygotes are the only source for the seed population of G. monilata blooms in the Indian River lagoon system. (Baker-IVI)
W84-02249

PUBLIC HEALTH AND WATER QUALITY SIGNIFICANCE OF VIRAL DISEASES TRANSMITTED BY DRINKING WATER AND RECREATIONAL WATER,
Rhode Island Univ., Kingston. Dept. of Microbiology.
V. J. Cabelli.
Water Science and Technology, Vol. 15, No. 5, p 1-15, 1983. 3 Fig, 2 Tab, 57 Ref. NOAA grant 80RAC00106.

Descriptors: *Viruses, *Public health, *Drinking water, *Swimming, Water pollution effects, Epidemiology, Hepatitis, Gastroenteritis, Water pollution effects, Recreation, Beaches, Wastewater pollution, Water quality standards.

A review of the available information from case and outbreak reports and the results of prospective and retrospective studies revealed that the potential for the spread of viral diseases by the use of fecally contaminated drinking and recreational water has only been realized for infectious hepatitis and viral gastroenteritis. These two, however, are the most serious and prevalent, respectively, of the water-related diseases. A model is described for predicting the beach specific, swimming-associated rates and annual number of cases of gastroenteritis. The inputs are the swimming-associated, gastroenteritis rate-bathing water enterococcus density regression equation developed from the USEPA prospective epidemiologic-microbiologic studies and the distribution of enterococcus density estimates and annual number of swimmers at the beach in question. In general, the gastroenteritis rates predicted from the enterococcus model were less than those from the corresponding E. coli model. Detectable rates at the 75 percentile level and rates approaching or exceeding 5/1000 swimmers at the 90 percentile level were predicted for 7 and 14, respectively, of the 87 sampling station-beach associations. All but one of the fourteen stations were potentially impacted by known municipal wastewater discharges and two of the associated beaches were posted as unsafe for swimming. The inapplicability of the model to beaches impacted with small, immediate sources of fecal wastes or stormwater run-off is noted. The limitations in the use of findings from the analysis of outbreak reports in the evaluation and establishment of water quality criteria, and hence, the need for prospective, drinking water and shellfish epidemiological studies is discussed. The need for such studies also derives from the results of the bathing beach study in that they suggest that cases of gastroenteritis are occurring with acceptable drinking and shellfish growing waters. The need for tissue culture enumerative methods for the viral gastroenteritis agents and methodology for determining the biological decay coefficients for these agents and their indicators is noted. (Author's abstract)
W84-02255

PREVALENCE OF VIRAL HEPATITIS AND OTHER ENTERIC DISEASE IN COMMUNITIES UTILIZING WASTEWATER IN AGRICULTURE,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 3C.
W84-02258

TAINTED FISH CAUSED BY PETROLEUM COMPOUNDS - A REVIEW,
Kagoshima Univ. Shimoarata (Japan). Faculty of Fisheries.
T. Motohiro.
Water Science and Technology, Vol. 15, No. 6-7, p 75-83, 1983. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Water pollution effects, *Oil pollution, *Hydrocarbons, *Fish, *Taste, Aromatic compounds, Paraffins, Sulfur compounds, Fish food, Algae.

A number of compounds present in petroleum can produce an oily flavor in fish. These are saturated and unsaturated paraffins, aromatic hydrocarbons and sulfur compounds. The intensity of oily flavor to some extent depends upon type, number of carbons and molecular structure of causative hydrocarbons. The qualitative and quantitative analyses indicate that there are many different types of petroleum compounds to which off-flavors are attributed, since feeding behavior to oil tainted food differs with species of aquatic organisms. Benzothiophene, toluene, xylene and benzene may not only produce an oily flavor in fish, but also they inhibit the enzyme reactions in the energy transfer system. Methionine synthesis in fresh sea weeds can also be inhibited as indicated by lower levels of dimethyl-beta-propiothetin in sea weeds grown on the oiled rock. (Author's abstract)
W84-02271

CASE STUDIES ON OFF-FLAVOURS IN SOME NORWEGIAN LAKES,
Norsk inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5F.
W84-02277

ODOROUS COMPOUNDS OF DIFFERENT STRAINS OF ANABAENA AND NOSTOC (CYANOBACTERIA),
Institut fur Chemische Pflanzenphysiologie der Universitat, Tubingen (Germany, F.R.).
S. Mohren, and F. Juttner.
Water Science and Technology, Vol. 15, No. 6-7, p 221-228, 1983. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Odor, *Anabaena, *Nostoc, Hydrocarbons, Alcohols, Aldehydes, Ketones, Acetone, Butan-2-one, Algae.

The odorous compounds of different strains of Anabaena and Nostoc were identified by gas chromatography and mass spectrometry. The Anabaena and Nostoc strains used produced different patterns of volatile substances including hydrocarbons, alcohols, aldehydes and ketones. A. oscillarioides produced high concentrations of compounds with C8 - skeletons with different substituents and unsaturations. The major compounds were oct-2-en-1-ol, oct-1-en-3-ol, octa-1,5-dien-3-ol and octa-1,trans 3, cis 5-triene. Together with numerous substances found in low concentrations, the two Nostoc strains produced acetone and butan-2-one. Anabaena PCC 7120 and A. flos-aquae produced trace amounts of different odorous compounds. Lack of nor-carotenoids such as beta-ionone, beta-cyclocitral and 6-methylhept-5-en-2-one is pointed out. (Author's abstract)
W84-02278

ISOLATION AND IDENTIFICATION OF ODOUROUS COMPOUNDS FROM A LAKE SUBJECT TO CYANOBACTERIAL BLOOMS,
National Research Council of Canada, Saskatoon, Saskatchewan. Prairie Regional Lab.
G. P. Slater, and V. C. Blok.
Water Science and Technology, Vol. 15, No. 6-7, p 229-240, 1983. 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Cyanophyta, *Eutrophication, *Taste, *Odor, *Buffalo Pound Lake, Saskatchewan, Anabaena, Oscillatoria, Aphanizomenon, Geosmin, Beta-cyclocitral.

Buffalo Pound Lake in southern Saskatchewan, Canada, is subject to heavy blooms of blue-green algae, mainly Anabaena, Oscillatoria and Aphanizomenon. The occurrence of any of these species is usually followed by the appearance of pronounced tastes and odors. Water samples were extracted using a Likens-Nickerson or continuous liquid-liquid apparatus and capillary GC of the extracts showed that a large number of compounds are always present although the taste and odor vary in intensity. Many of these compounds have been identified using capillary GC-MS. Geosmin, which imparts a muddy flavor to water, was detected but methylisoborneol was absent. Other compounds present in the water included alkanes, alkylbenzenes, acetophenone, cyclohexanone, phenylacetonitrile, and alpha-pinene, some of which could affect the palatability of the water. Although some water samples had a musty odor, extracts were frequently dominated by a pungent, smoky or tobacco flavor consistent with the presence of beta-cyclocitral which was also indicated by GC-MS. (Author's abstract)
W84-02279

OSCILLATORIA BREVIS (KUTZ.) GOM. AND SOME OTHER ESPECIALLY ODOURIFEROUS BENTHIC CYANOPHYTES IN NORWEGIAN INLAND WATERS,
Norwegian Inst. for Water Research, Oslo.
L. Berglind, I. J. Johnsen, K. Ormerod, and O. M. Skulberg.
Water Science and Technology, Vol. 15, No. 6-7, p 241-246, 1983. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Oscillatoria, *Cyanophyta, *Norway, *Odor, Algae, Geosmin, Methyliosborneol, Actinomycetes, Phormidium, Algal mats, Benthic algae.

Obnoxious odors are connected with the growth of the cyanophyte Oscillatoria brevis in benthic algal mats in Norwegian inland waters. Axenic cultures of the O. brevis clone NIVA CYA 7 produced strong muddy smelling compounds, geosmin and 2-methylisoborneol. The correlation between pr. fuse development of benthic cyanophytes and off-flavor problems indicates that these organisms are liable for the effect. The interrelationships between cyanophytes and Actinomycetes in benthic algal growth of inland water (mats of blue-green algae such as Oscillatoria and Phormidium) requires further research. (Moore-IVI)
W84-02280

ODOR PROBLEMS IN LAKE BIWA,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
For primary bibliographic entry see Field 5F.
W84-02284

CHANGES IN TURBIDITY AS A RESULT OF MINERALISATION IN THE LOWER VAAL RIVER,
D. C. Grobler, D. F. Toerien, and J. S. de Wet.
Water South Africa, Vol. 9, No. 3, p 110-116, July, 1983. 7 Fig, 3 Tab, 16 Ref.

Descriptors: *Turbidity, *Mineralization, *Vaal River, *South Africa, Rivers, Water supply, Water quality control, Conductivity, Bloemhof Dam, Prediction.

Highly significant correlations were determined between annual mean values of turbidity (NTU), electrical conductivity (EC) and sodium adsorption ratio (SAR) of the lower Vaal River. A non-linear regression NTU = 1959 - (EC, mS/m) + 9.6 which explained 64% of the variance of turbidity, was derived and can be used for predictions for the lower Vaal River. The extinction coefficient of Bloemhof Dam was related to turbidity according to k = 0.127 (NTU) + 0.55. Thus, the photic zone depth of the lower Vaal River can be predicted for different mineralization (=EC) levels. Future water quality management procedures need this information. (Author's abstract)
W84-02311

MODELING OF THE OXYGEN REGIME OF A FRESHWATER BODY DURING SUMMER HEATING,
Moscow State Univ. (USSR).
For primary bibliographic entry see Field 2I.
W84-02318

COMBINED EFFECTS OF TEMPERATURE AND SALINITY ON CUTTLEFISH (SEPIA OFFICINALIS L.) HATCHING,
CNR, Lesina (Italy). Ist. per la Struttamento Biologica delle Lagune.
G. B. Palmegiano, and M. P. D'Apote.
Aquaculture, Vol. 35, No. 3, p 259-264, 1983. 2 Tab, 14 Ref.

Descriptors: *Fish hatcheries, *Temperature effects, *Salinity, Lagoons, Seasonal variations, Cephalopods, Italy, Lesina lagoon, Cuttlefish, Brackish water.

In an investigation of conditions suitable for achieving commerical production of Sepia officinalis L. in a brackish lagoon by means of egg sowing, the hatching of the eggs of this marine cephalopod were studied under different combined temperatures and salinity conditions. Two series of experiments (3 x 3 and 3 x 2 designs) were run over the temperature range 15-24 degrees C and the salinity range 23-33 0/00 S. Temperature was found to affect only the incubation time, and its relevant regression function is calculated. Salinity had a significant inhibitory effect on hatching at all of the temperatures investigated. No interactive effect between the two parameters was observed. A comparison is made with the results obtained using other temperature and salinity profiles relating to the Lesina lagoon. It is concluded that the environmental conditions occurring in May represent the minimum conditions for obtaining a marketable size harvest in autumn. It is in fact during this period that the lagoon water reaches a temperature of about 20 degrees C and a salinity of 28 0/100, allowing 50% hatching to be achieved in 30 days. (Author's abstract)
W84-02381

TUBIFICIDAE OF THE LITTORAL OF LAKE CONSTANCE, REGARDING ESPECIALLY POTAMOTHRIX MOLDAVIENSIS (DIE LITORALEN TUBIFICIDAE DES BODENSEES MIT BESONDERER BERUCKSICHTIGUNG VON POTAMOTHRIX MOLDAVIENSIS),
For primary bibliographic entry see Field 2H.
W84-02386

EFFECTS OF ACID PRECIPITATION ON EMBRYONIC MORTALITY OF AMBYSTOMA SALAMANDERS IN THE CONNECTICUT VALLEY OF MASSACHUSETTS,
Massachusetts Univ., Amherst. Dept. of Forestry and Wildlife Management.
R. P. Cook.
Biological Conservation, Vol. 27, No. 1, p 77-88, 1983. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Acid rain, *Mortality, *Salamanders, Connecticut Valley, Massachusetts, Acidification, Embryos, Ponds, Water pollution effects, Hydrogen ion concentration, Acidity.

The phenomenon of increased embryonic mortality of the spotted salamander Ambystoma maculatum concomitant with breeding pond acidification from acid rainfall was investigated in the Connecticut Valley of Massachusetts. The pH and chemistry of rain and pond water were analysed, and embryonic mortality of spotted and Jefferson salamanders A. jeffersonianum was monitored in 1976 and 1977. Rainfall pH, 4.16 and 4.07 in 1976 and 1977, respectively, indicates that acid rain continues to occur in the area. Ambystoma breeding ponds are acidic, due to background and rainfall acidity. The average pH of six ponds dropped from 5.62 in 1976 to 5.10 in 1977. Pond pH decreased up to 0.75 pH units following heavy rainfall. These trends indicate that pond acidification from acid rain is occurring. Despite pond acidity, embryonic mortality of spotted and Jefferson salamanders was low. For spotted salamanders, mortality ranged from 2.1 to 30.2%, with 15 of 17 ponds below 16%. Embryonic mortality of Jefferson salamanders ranged from 12.4 to 40.3%. No significant correlation between pond pH and percent embryonic mortality was found. Estimates based on numbers of breeding females showed Connecticut Valley spotted salamander populations to be larger than in areas where their decline has been correlated with acid rain. The size of present populations, and the embryonic acid tolerance exhibited by

spotted and Jefferson salamanders, indicate that acid rain has not affected their populations in the Connecticut Valley of Massachusetts. (Author's abstract)
W84-02388

EFFECTS OF ACIDITY OF SIMULATED RAIN AND ITS JOINT ACTION WITH AMBIENT OZONE ON MEASURES OF BIOMASS AND YIELD IN SOYBEAN,
Boyce Thompson Institute, Ithaca, NY.
J. Troiano, L. Colavito, L. Heller, D. C. McCune, and J. S. Jacobson.
Environmental and Experimental Botany, Vol. 23, No. 2, p 113-119, 1983. 5 Tab, 15 Ref.

Descriptors: *Acid rain, *Ozone, *Air pollution, *Soybeans, Biomass, Crop yield, Acidity, Plant growth.

An experiment was performed to determine whether the presence of ozone modified the effects of acidity of simulated rain on growth and yield of soybean (Glycine max) Beeson, a type II cultivar, was grown in field chambers and exposed to simulated rain at 3 levels of acidity, pH 4.0, 3.4 and 2.8. Each level of acidity was applied to plants grown either in unfiltered ambient air or in charcoal filtered (to remove ozone) ambient air. An interaction between acidity of simulated rain and filtration of ambient air on growth and yield was present. The difference in total dry mass between plants grown in filtered and unfiltered chambers increased with increased acidity, of simulated rain treatments. In filtered air, vegetative mass was only slightly decreased with increased acidity, whereas reproductive mass was increased with increased acidity. In unfiltered air vegetative mass decreased with increased acidity but reproductive mass was only slightly decreased at pH 2.8. Components of yield also were differentially affected by acidity, which indicates the need for a better understanding of the sensitivities of different developmental processes of the plant to each kind of pollutant. The apparent interaction between ozone and acidic rain indicates that further investigations on this combination must be conducted before acidic rain effects on plant growth can be accurately assessed in ambient atmospheres. (Author's abstract)
W84-02392

SENSITIVITY RATINGS OF SOILS TO ACID DEPOSITION: A REVIEW,
Purdue Univ., Lafayette, IN. Dept. of Agronomy.
W. W. McFee.
Environmental and Experimental Botany, Vol. 23, No. 3, p 203-210, 1983. 1 Fig, 2 Tab, 39 Ref.

Descriptors: *Soil chemistry, *Acid precipitation, *Soil acidification, Acid deposition, Acidification, Atmospheric deposition, Soil classification.

Atmospheric deposition concerns related to soils are mostly associated with nutrient supplying capacity for higher plants and losses through renoff and leaching to aquatic systems. These impacts present a possivliity of serious damage to the soil's abliity to support vigorous plant growth and protect the quality of water. Acid precipitation is so widespread and the potential harm is subtle, so there is a need to concentrate research efforts in areas most likely to be susceptible. One of the difficulties in studying the effects of acidic deposition on soils has been the failure to clearly differentiare between effects of acidic deposition and soil acidification. The latter is an almost ubiquitous process in humid climates. Sources of soil acidity include several natural processes such as nitrification, organic matter decomposition and CO2 production by soil organisms as well as acidic deposition. The acid inputs from ambient atmospheric deposition are 1-2 orders of magnitude smaller than the effects of common agricultural practices such as N fertilization and liming. Soil sensitivity rating systems are compared, and the strengths and theoretical bases of each are discussed. All of the systems were aimed at broad regional mapping and contain many variations within units. They do not define areas where soil damage is occurring, but suggest which soils should be examined first in a search for acidic deposition effects. (Moore-IVI)
W84-02393

IMPACTS OF ACID DEPOSITION ON N AND S CYCLING,
Nebraska Univ.-Lincoln.
R. A. Olson.
Environmental and Experimental Botany, Vol. 23, No. 3, p 211-223, 1983. 4 Fig, 3 Tab, 50 Ref.

Descriptors: *Acid rain, *Soil chemistry, Nitrogen, Sulfur, Acid deposition, Hydrogen ion concentration, Nutrients, Soil acidification, Alkaline soils, Calcareous soils, Agriculture.

Modern concern on the environmental impact of 'acid rain' centers especially on the oxides of N and S. More appropriately expressed as 'acid deposition', the topic has been related largely to impacts on human health and man-made structures with focus only in recent years on possible damage to soils and agricultural production. Likely deleterious effects on soils include reduction in pH, increased activity of various elements with toxicity potential, accelerated mineral weathering and leaching of reserve soil nutrients and undesirable changes in the soil microflora. Areas with greatest potential for soil damage from deposition are in close proximity and downwind from large coal-burning plants, especially where shallow and/or coarse textured soils exist on inaccessible mountainous positions with forest cover. For most of the agricultural regions of this country and the world, however, the N and S fallout products are more beneficial in supplying needed plant nutrients than they are detrimental. Their acidification capacity is insignificant in comparison with that of natural N and S transformations in soils or that induced by conventional fertilizer programs of farmers. The slight acidification imposed over the long term can improve calcareous and alkali soils as growth media and is readily corrected by liming of the acid soils made more acid than desirable or crop production. (Author's abstract)
W84-02394

IMPACTS OF ACID DEPOSITION ON SOIL BIOTA AND C CYCLING,
Colorado State Univ., Fort Collins. Dept. of Zoology and Entomology.
D. C. Coleman.
Environmental and Experimental Botany, Vol. 23, No. 2, p 225-233, 1983. 7 Fig, 3 Tab, 37 Ref.

Descriptors: *Acid rain, *Soil chemistry, *Acid deposition, Soil biota, Ecosystems, Tillage, Soil acidity, Acidification, Grasslands, Litter, Forests, Decomposition, Carbon cycling, Primary productivity, Detritus, Soil solution, Nitrogen, Sulfur, Phosphorus, Reviews.

Abiotic and biotic factors in agricultural soils, including range and cropland, are examined in the context of soil biota and carbon cycling. This review looks at a variety of man-managed ecosystems over a range of from minor to major man-managed perturbations. Major emphasis is placed on the results from experimental manipulations of acidity in grasslands and forests and on developing knowledge in zero-till vs. conventional tillage agriculture. In terms of both carbon and energy flow, a majority of the action follows the primary production detritus/decomposer pathway. Certain litter-dwelling organisms and attendant processes, such as litter decomposition, are seriously impacted by decreasing pH. A conceptual model was developed for comparing microbial faunal an plant growth dynamics in conventional vs. no-till situations. The flows indicate breakdown mediated by microbial activity and controlling faunal populations either by direct microbial grazing or predators and top carnivores feeding on the grazers, returning N, P, and S to the soil solution, which is then taken up by plant roots. There are possible inhibiting effects of acid deposition, particularly if the target organisms are concentrated near the soil surface. Further studies in both theoretical and applied ecology are required to answer important questions of stress or effects, such as acid deposition in agro-ecosystems. (Moore-IVI)
W84-02395

IMPACT OF ACID DEPOSITION AND P CYCLING,
Colorado State Univ., Fort Collins. Dept. of Agronomy.
C. V. Cole, and J. W. B. Stewart.
Environmental and Experimental Botany, Vol. 23, No. 3, p 235-241, 1983. 5 Fig, 1 Tab, 15 Ref.

Descriptors: *Acid rain, *Acid deposition, *Soil chemistry, *Phosphorus, Nutrient cycling, Agriculture, Ecosystems, Soil erosion, Weathering, Soil management.

The productivity of agricultural soils requires an active cycling of soil P pools through plants and microbial populations. P cycling rates are thus closely linked to transformations of C, N, S and other mineral nutrients. A systems approach to an understanding of factors controlling chemical and biological processes in ecosystems is necessary for an evaluation of the impacts of acid deposition on agricultural soils. Acid deposition effects on P cycling will be most pronounced on soils subject to intense weathering and erosional processes. Management practices developed to relieve these stresses will be most useful in mitigating impacts of acid deposition. (Author's abstract)
W84-02396

IMPACTS OF ACID DEPOSITION ON MICRONUTRIENT CYCLING IN AGRO-ECOSYSTEMS,
Tennessee Valley Authority, Muscle Shoals, AL. National Fertilizer Development Center.
J. J. Mortvedt.
Environmental and Experimental Botany, Vol. 23, No. 3, p 243-249, 1983. 5 Tab, 22 Ref.

Descriptors: *Micronutrients, *Acid rain, *Acid deposition, *Soil chemistry, Soil acidification, Agriculture, Plant nutrients, Hydrogen ion concentration, Buffering capacity, Acid soils, Farming.

Plant availability of all micronutrients except Mo increases with increasing soil acidity. Toxicities due to Mn and Al in extremely acid soils may result in decreased crop yields. Changes in soil pH due to acid depositions are minimal in most agricultural soils because of relatively high buffering capacities of these soils. Modern farming practices such as liming and return of crop residues also may override depositional effects. Therefore, micronutrient cycling in most agro-ecosystems should not be significantly affected by acid depositions. The long-term effects of acid depositions are not known. Plant micronutrients include B, Cu, Fe, Mn, Mo and Zn. Although Cl and Co are also micronutrients, their supply in most agro-ecosystems is usually sufficient. Micronutrient cycling in agro-ecosystems is a complex series of processes involving micronutrient additions to and removal from soils and changes in the chemical forms, solubilities and consequent availabilities of micronutrients to plants induced by changes in the ecosystem. Crop removal and erosion of surface soils result in losses of micronutrients from agricultural soils. Return of crop residues to soils mitigates such losses by returning some of the plant-contained micronutrients and by reducing the potential for erosion. High rates of acid deposition on poorly buffered soils over a period of time may result in measurable changes in soil acidity. Unless a soil is near the critical pH level for Mn or Al toxicity (usually about pH 5.0), soil acidification due to acid precipitation should not have an adverse effect on plant growth. Decreases in soil pH would increase plant uptake of all micronutrients except Mo, but a large fraction of the increased uptake usually would be recycled to soil with the return of crop residues. (Moore-IVI)
W84-02397

IMPACT OF SEDIMENT-ASSOCIATED CONTAMINANTS FROM THE NIAGARA RIVER MOUTH ON VARIOUS SIZE ASSEMBLAGES OF PHYTOPLANKTON,
Canada Centre for Inland Waters, Burlington, Ontario. Great Lakes Fisheries Research Branch.
M. Munawar, A. Mudroch, I. F. Munawar, and R. L. Thomas.

Journal of Great Lakes Research, Vol. 9, No. 2, p 303-313, 1983. 4 Fig, 6 Tab, 25 Ref.

Descriptors: *Sediments, *Phytoplankton, *Water pollution effects, *Niagara River, *Lake Ontario, Bioassays, Metals, Nutrients, Organic compounds, Algae.

The impact of elutriated sediment-associated contaminants from the Niagara River mouth and from a midlake station in Lake Ontario on various size assemblages of natural phytoplankton was determined. The C-14 fractionation bioassays indicated that the addition of Chelex-treated elutriate (without dissolved metals) from the Niagara River mouth enhanced the C-14 uptake when composed to the standard elutriate. Conversely, at the midlake station, the addition of standard elutriate (with dissolved metals) induced higher C-14 uptake from the Chelex-treated elutriate. The synergistic effects of nutrients/metals and metals/organic compounds determine the bioavailability and toxicity of contaminants to natural phytoplankton. The technique is sensitive and useful in detecting the differential response of algal size fractions to contaminants. (Author's abstract)
W84-02419

VARIATIONS OF THE AQUATIC VEGETATION OF THE WELLAND RIVER (ONTARIO, CANADA) ABOVE AND BELOW AN INDUSTRIAL WASTE DISCHARGE,
Brock Univ., St. Catharines, Ontario. Dept. of Biological Sciences.
M. Dickman, C. Prescott, and K. L. E. Kaiser.
Journal of Great Lakes Research, Vol. 9, No. 2, p 317-325, 1983. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Welland River, *Ontario, *Aquatic plants, *Industrial wastes, *Water pollution effects, Effluents, Bioindicators, Typha, Sagittaria, Nitzschia, Cyanophyta, Chlorophyta, Diatoms, Species composition, Conductivity.

The zonation of aquatic macrophytes, particularly Typha and Sagittaria sp. and associated periphyton communities, were investigated in relation to industrial point source discharges to the Welland River, Ontario. Continuous conductivity was consistently higher and more variable downstream of the industrial effluents than upstream, particularly below the Thompson Creek confluence. Zonation of macrophytes in response to waste streams was evident. Immediately downstream of effluent discharges, no macrophytes occurred. Typha was first to return, followed by Sagittaria, and eventually submersed aquatics reinvaded at increased distance (1.6 km) downstream. Size and density of Typha stands also increased with distance from the discharges. The periphyton community also showed alteration in response to waste discharges. Species richness and diversity were lowest immediately downstream of the discharges and increased with distance downstream. Blue-green algae were the dominant forms at all stations, especially at those nearest waste discharges. Filamentous green algae displayed the opposite trend, becoming more common with distance downstream below discharges. Diatoms displayed no consistent trend in response to waste discharges. Replacement of Nitzschia dissipata by N. palea occurred immediately downstream of Thompsons Creek, but not at the other discharge site. (Moore-IVI)
W84-02420

FIELD AND LABORATORY STUDIES OF ENVIRONMENTAL CARCINOGENESIS IN NIAGARA RIVER FISH,
Roswell Park Memorial Inst., Buffalo, NY.
J. J. Black.
Journal of Great Lakes Research, Vol. 92, No. 2, p 326-334, 1983. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Fish diseases, *Polycyclic aromatic hydrocarbons, *Carcinogens, *Niagara River, New York, Toxicity, Bottom sediments, Sediments, Fish, Industrial wastes, Water pollution effects.

The pattern of polycyclic aromatic hydrocarbon (PAH) contamination in a localized segment of the Great Lakes aquatic environment are sufficiently defined to suggest that industrial discharges along the shoreline of eastern Lake Erie and the upper Niagara River near Buffalo, NY have resulted in greatly increased sediment concentrations of these compounds. Field studies of fish tumor pathology have indicated elevated frequencies of neoplastic disease among several species of fish. Laboratory studies have been able to induce epidermal hyperplasia and papillomas as a result of repeated exposure to a complex PAH-containing mixture derived from polluted river sediments. This provides initial evidence linking tumors in some feral fish species to waterborne carcinogenic chemicals present in urban and industrial wastes. (Baker-IVI)
W84-02421

EFFECTS OF ELEVATED THERMAL REGIMES ON SURVIVAL OF RAINBOW TROUT (SALMO GAIRDNERI) ALEVINS,
Ontario Hydro, Toronto. Research Div.
D. W. Rodgers, and J. S. Griffiths.
Journal of Great Lakes Research, Vol. 9, No. 3, p 421-424, 1983. 1 Fig, 1 Tab, 13 Ref.

Descriptors: *Thermal pollution, *Trout, *Water pollution effects, *Growth stages, Embryos, Alevins, Mortality, Hatching.

Embryos of fall spawning rainbow trout were incubated and alevins reared under thermal regimes characteristic of ambient winter nearshore Lake Ontario and elevated thermal regimes 2 and 5 C degrees warmer than ambient. Embryos incubated under elevated thermal regimes hatched and attained 50% swim-up sooner than embryos incubated under the ambient thermal regime. In general, mortality of alevins at 21 and 28 days after swim-up was low for all rearing thermal regimes. The generally low mortality of alevins incubated and reared under the various thermal regimes suggests that rainbow trout alevins have fairly broad thermal tolerances when food is provided to excess. (Author's abstract)
W84-02426

CONE-SHAPED HYPOLIMNION AND LOCAL REACTOR AS OUTSTANDING FEATURES IN EUTROPHICATION OF LAKE MARACAIBO,
Estudios y Controles en Contaminacion, Caracas (Venezuela).
G. Parra-Pardi.
Journal of Great Lakes Research, Vol. 9, No. 4, p 439-451, 1983. 13 Fig, 10 Ref.

Descriptors: *Eutrophication, *Hypolimnion, *Lake Maracaibo, *Venezuela, Salinity, Water circulation, Vortex, Anoxic conditions, Nitrogen, Phosphorus, Nutrients, Water temperature, Algae.

Between 1974 and 1979 a large-scale research program to identify and evaluate the pollution problems in tropical Lake Maracaibo (Venezuela) was undertaken. Two unique limnological features investigated during this program were a cone-shaped hypolimnion in the center of the lake and an area of unusually high biologic activity within the northeastern coastal area. The unique cone-shaped hypolimnion exists in the lake as a result of a counterclockwise vortex circulation system. The base of the cone is in the center of the lake bottom and apex is at 5 to 15 m depth. Anoxic conditions, high salinity, and exceedingly high N and P concentrations are found in the hypolimnetic cone. Salinity in the cone is due to intrusion of diluted seawater, which on arriving at the deeper parts of the lake is incorporated into the hypolimnion and slowly dispersed through a process of erosion toward the epilimnion. The saline cone functions as an internal source of nutrients throughout the year at tropical temperatures (29 to 31 C). The plume of Catatumbo River exerts a considerable influence on the general limnoloical features of the lake, isolating the portion in the extreme southern section of the lake. The northeastern coastal area is likened to a biological reactor. Conditions favor accelerated eutrophication, with massive blooms of algae being common. It is characterized as a relatively low energy zone in relation to the horizontal movement of the water in the rest of the lake. (Moore-IVI)
W84-02428

5D. Waste Treatment Processes

MOVEMENT OF BACTERIA AND NUTRIENTS FROM PIT LATRINES IN THE BOUNDARY WATERS CANOE AREA WILDERNESS,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
For primary bibliographic entry see Field 5G.
W84-02136

STABILITY OF COLLOIDS IN AQUEOUS SYSTEMS. THE ROLE OF THE ZETA POTENTIAL AND THE INFLUENCE OF ADSORBED POLYMERS (ZUR STABILITAT VON KOLLOIDEN IN WASSRIGEN SYSTEMEN. DIE ROLLE DES ZETAPOTENTIALS UND DER EINFLUSS ADSORBIERTER POLYMERE),
Agricultural Univ., Wageningen (Netherlands). Dept. of Physical and Colloid Chemistry.
B. H. Bijsterbosch.
Zeitschrift fur Wasser und Abwasser Forschung, Vol. 16, No. 4, p 125 and 127-131, 1983. 10 Fig, 14 Ref.

Descriptors: *Colloids, *Coagulation, *Polymers, *Electrokinetics, Flocculation, Ionic strength, Solutions.

How the interaction forces between two colloidal particles in solution depend on their mutual distance and what influence ionic strength exerts on this interplay are explained. The ensuing picture constitutes the basis of the DLVO-theory of colloidal stability. In the expression for the coagulation concentration that follows from this theory, an important role is played by the diffuse double layer potential. This potential usually can not directly be inferred from experiments and it is thus assumed to be equal to the electrokinetic zeta-potential. The way in which zeta can be obtained from electrophoretic or other electrokinetic experiments is indicated. The presence of polymers in a colloidal system can influence its stability quite markedly. It can as well be enhanced (protection) as be eliminated (flocculation). It appears that the mixing of the components can be crucial in this respect. (Author's abstract)
W84-02140

CARRIER MEDIATED EXTRACTION: APPLICATION OF DOUBLE EMULSION TECHNIQUE FOR MERCURY REMOVAL FROM WASTE WATER,
Academy of Agricultural Sciences, Sofia (Bulgaria). Central Lab. of Chemical Engineering.
L. Boyadzhiev, and E. Bezenshek.
Journal of Membrane Science, Vol. 14, No. 1, p 13-18, June, 1983. 6 Fig, 23 Ref.

Descriptors: *Mercury, *Carrier mediated extraction, *Wastewater treatment, Heavy metals, Waste recovery.

Extraction of mercury(II) cations from low-pH aqueous solutions by means of a double emulsion technique was studied in a laboratory scale, 2 L turbine agitator. A 10% solution of long-chain fatty acids (oleic and linolic) in normal paraffins (C11-C15) was used as the intermediate phase. The optimal operational conditions for fast and complete removal of mercury, providing a 1000-fold concentration increase of the metal in the receiving, encapsulated phase, were obtained. The extraction of mercury at relatively low concentration from wastewater using the double emulsion technique reveals the principle positive features of carrier mediated extraction: fast and efficient removal of the desired species in a single-stage process and reduced consumption of the extracting agent, because only a small quantity of low-concentration organic phase is used. Considering the practical and economical aspects of the problem, this method, with properly chosen operational conditions, could be an efficient tool for large-scale removal and recovery of mercury from wastewaters. (Moore-IVI)
W84-02143

OBSERVATIONS SUPPORTING PHOSPHATE REMOVAL BY BIOLOGICAL EXCESS UPTAKE - A REVIEW,
Cape Town Univ. (South Africa). Dept. of Water Resources and Public Health Engineering.
G. V. R. Marais, R. E. Loewenthal, and I. P. Siebritz.
Water Science and Technology, Vol. 15, No. 3/4, p 15-41, 1983. 11 Fig, 45 Ref.

Descriptors: *Activated sludge process, *Phosphorus removal, *Wastewater treatment, Biological wastewater treatment, Anaerobic digestion, Aerobic treatment, Reviews.

The development of the biological excess removal of phosphorus in the activated sludge process is reviewed from 1959 to the present time. Evidence is presented which supports the claim that phosphorus removal is accomplished through biological mechanisms. Even so, the theoretical description, in both a biochemical or bioenergetic sense, is still in a very fundamental stage. The customary black box approach which has dominated developments in this field as well as the application to design and optimization of phorphorus removal plants has probably passed the peak of its usefulness as a research tool. The direction of future research will likely be influenced increasingly by the biochemical aspects of the phenomena. Significant advances in this area will likely come from the greater understanding of the biochemical mechanisms controlling the phenomenon. (Baker-IVI)
W84-02144

FULL SCALE EXPERIENCE WITH PHOSPHORUS REMOVAL IN AN ALTERNATING SYSTEM,
Akvadan-Harvey A/S, Bagsvaerd (Denmark).
E. Bundgaard, G. H. Kristensen, and E. Arvin.
Water Science and Technology, Vol. 15, No. 3/4, p 197-217, April 1983. 9 Fig, 6 Tab, 16 Ref.

Descriptors: *Nitrogen removal, *Phosphorus removal, Wastewater treatment, Alternating mode of operation, Aerobic conditions, Anoxic conditions, Anaerobic conditions, Nitrates, Nitrites, Oxygen, Sludge, Chemical precipitation, Ferrous sulfate.

Nitrogen removal performed by the alternating mode of operation results in alternating aerobic, anoxic and anaerobic conditions during different operational sequences of the treatment process. Phosphorus release and phosphorus uptake have been observed under the anaerobic and aerobic conditions respectively. Phosphorus release is observed when oxygen, nitrate, and nitrite are absent in the bulk liquid. With oxygen or nitrate present re-uptake of phosphorus is observed. Therefore, information about the dynamic parameter variations in the reactors is considered important in order to optimize the effluent phosphorus quality. Operational results from two treatment plants show enhanced phosphorus removal: 8 mg P/l out of 11 mg P/l in the inlet is removed. Chemical analyses of sludge samples indicate that precipitation of a calcium-iron-phosphate is responsible for the enhanced phosphorus removal. The precipitate constitutes 12% of the total sludge mass. At one treatment plant nitrogen removal is combined with phosphorus removal by simultaneous precipitation with ferrous sulfate. Even in this system phosphorus release and phosphorus uptake is observed, and knowledge about the dynamic parameter variation during the alternating mode of operation can be used to ensure a stable and low effluent phosphorus concentration. (Author's abstract)
W84-02145

PERFORMANCE AND OPERATIONAL ASPECTS OF BIOLOGICAL PHOSPHATE REMOVAL PLANTS IN SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
B. H. Paepcke.
Water Science and Technology, Vol. 15, No. 3/4, p 219-232, 1983. 1 Fig, 2 Tab, 6 Ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Biological wastewater treatment, South Africa, Nitrates, Denitrification, Dissolved oxygen, Entrainment, Sludge.

A survey was undertaken of the operation and performance of eleven multi-stage activated sludge plants in South Africa designated for biological nitrogen and phosphorus removal. The results indicate that phosphorus removal has been consistently good in only one case, although several other plants have performed very well in recent months. The major factors adversely affecting phosphorus removal are excessive amounts of nitrate and dissolved oxygen in the anaerobic basins. Nitrate is introduced into the anaerobic basin in the return activated sludge when denitrification is incomplete. Incomplete denitrification is due to a disproportionately low amount of carbonaceous matter in the influent wastewater relative to the total nitrogen concentration. The dissolved oxygen is the result of air entrainment at the Archimedes screw return activated sludge pumps, at cascades in the influent and return sludge channels, and by vortices caused by the stirrers. Other factors which have significantly affected plant performance are mechanical problems, inadequate operator training, and insufficient sample analyses on which to base operating decisions. With due recognition paid to these problem areas, the performance of future designs should be much improved. (Author's abstract)
W84-02146

PRACTICAL EXPERIENCE WITH BIOLOGICAL PHOSPHORUS REMOVAL PLANTS IN JOHANNESBURG,
A. R. Pitman, S. L. V. Venter, and H. A. Nicholls.
Water Science and Technology, Vol. 15, No. 3/4, p 233-259, 1983. 7 Fig, 13 Tab, 14 Ref.

Descriptors: *Activated sludge process, *Biological wastewater treatment, *Phosphorus removal, *Nitrogen removal, Johannesburg, South Africa, Wastewater facilities, Nitrates, Dissolved oxygen, Load distribution.

Biological phosphorus removal at Johannesburg's two first generation full-scale biological nutrient removal activated sludge plants has not been as successful and easily achieved as one would like. At Goudkoppies, phosphorus removal was fairly good with many periods when effluent levels were well below 1 mg P/l. Performance was erratic with effluent phosphorus peaks often occurring, particularly on Tuesdays. The process sensitivity was largely due to the underloaded nature of the plant and the poor characteristics of the feed sewage. At Northern Works, phosphorus removal was found to be virtually impossible due to the normally grossly underloaded operating conditions. It was only when the load was boosted with primary sludge that this plant removed significant quantities of phosphate. Phosphorus removal was dependent on the maintenance of optimum anaerobic conditions in the first (anaerobic) zone of the process. Optimum anaerobic conditions could be achieved by limiting the input of dissolved oxygen and nitrate to this zone and stimulating a release of phosphate into solution to concentrations in excess of the feed levels. Factors which mitigated against the maintenance of release were the ingress of dissolved oxygen and nitrate via the feed, return sludge or backmixed flow from the first anoxic zone and the low COD in the feed over weekends, holidays and storm periods. In these underloaded plants, phosphorus and nitrogen removal appeared to be in conflict for when oxygen levels were increased to ensure complete nitrification, denitrification was often incomplete, resulting in the backmixing of excessive nitrate the the anaerobic zone and the consequent loss of release. Phosphorus removal and good settling sludges appear to also be in conflict in the plants. (Moore-IVI)
W84-02147

FULL SCALE PHOSPHATE REMOVAL EXPERIENCES IN THE UMHLATUZANA WORKS AT DIFFERENT SLUDGE AGES,
Pinetown Municipality (South Africa)
D. A. Kerdachi, and M. R. Roberts.
Water Sciences and Technology, Vol. 15, No. 3/4, p 261-281, 1983. 5 Fig, 7 Tab, 23 Ref.

Descriptors: *Phosphorus removal, *Activated sludge process, *Biological wastewater treatment, Wastewater treatment, Nitrogen removal, Anaerobic conditions, Acinetobacter, Quasi-plug flow, Retention time, Umhlatuzana Works, South Africa.

The 4.8 Ml/d average dry weather flow, Umhlatuzana Wastewater Treatment Plant was designed to meet the South African General Standard; no special provision for nutrient removal was made in the design, but an extraordinarily high sludge recycle capacity was provided. The removal of high percentages of phosphate was first observed when the plant was operating at a sludge age of 20 days with total anaerobiasis for periods of 10 to 12 hours each day. Full-scale phosphate removal was studied at 69, 38 and 8 day sludge ages. Exceptionally good results were obtained treating an unsettled domestic wastewater in the simple activated sludge plant, under optimum operating conditions in a soft water region. At sludge ages of 69 and 38 days, more than 92% of the influent carbon, nitrogen and phosphorus were removed simultaneously and consistently without chemical addition or tertiary treatment. The success of the method is attributed to predominance of extracellular P-removal mechanism over intracellular mechanisms and to a novel combination of operating features: preliminary conditioning by daily prolonged anaerobiosis; restricted oxygen input and high non-aerobic fraction of process volume; quasi-plug-flow reactor with variable but controlled aerobic and non-aerobic zones; high sludge recycle ratio; and high mixed liquor suspended solids concentration. The low concentration of residual phosphate is probably governed by the equilibrium kinetics of a solid phosphate phase and not by microorganisms. Restricted oxygen input is associated with efficient phosphate removal and it is possible to condition activated sludge anaerobically so that its behavior changes gradually from the anaerobic phosphate release regime associated with luxury uptake by Acinetobacter to a regime of insignificant phosphate release associated with the most efficient phosphate removal. (Moore-IVI)
W84-02148

CONSIDERATIONS IN THE PROCESS DESIGN OF NUTRIENT REMOVAL ACTIVATED SLUDGE PROCESSES,
Cape Town Univ. (South Africa). Dept. of Civil Engineering.
G. A. Ekama, I. P. Siebritz, and G. V. R. Marais.
Water Science and Technology, Vol. 15, No. 3/4, p 283-318, 1983. 17 Fig, 4 Tab, 13 Ref.

Descriptors: *Wastewater composition, *Chemical oxygen demand, *Kjeldahl nitrogen, *Temperature, *Activated sludge process, Phosphorus removal, Nitrogen removal, Denitrification, Biological wastewater treatment, Sedimentation, Oxygen demand.

The average influent wastewater characteristics - (i) the COD concentration, (ii) the TKN/COD concentration ratio, (iii) the rapidly biodegradable COD concentration, (iv) the maximum specific growth rate of the nitrifiers at 20 C attainable in the wastewater, (v) the maximum and minimum temperatures, and (vi) the P/COD concentration ratio - are shown to govern the design of, and effluent quality from single sludge activated sludge processes for both biological nitrogen and phosphorus removal. The TKN/COD ratio governs the selection of the process type: for the Phoredox process, complete denitrification is essential to obtain excess P removal, and this is shown to be feasible only for TKN/COD ratios less than 0.07 to 0.08 mg N/mg COD; as the TKN/COD ratio increases above 0.08, complete denitrification becomes increasingly unlikely, and the UCT or Modified UCT processes are appropriate because in these processes complete denitrification is not essential to achieve P removal - in these processes N and P removal can be traded off against each other depending on the critical nutrient to be removed. Primary sedimentation significantly reduces the biological nutrient removal potential of activated sludge process because it increases the TKN/COD and P/COD ratios and reduces the COD load; however it significantly reduces the

process volume and total oxygen demand. (Author's abstract)
W84-02149

APPLICATION OF ELECTRODIALYSIS WITH ION-EXCHANGE MEMBRANES FOR TREATMENT OF SODIUM SULFATE SOLUTIONS,
Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow.
N. M. Smirnova, B. N. Laskorin, J. S. Michukova, and A. V. Borisov.
Desalination, Vol. 46, p 197-201, May, 1983. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Electrodialysis, *Ion exchange, *Sodium sulfate, *Wastewater treatment, Industrial wastewater, Wastewater renovation, Water reuse, Sulfuric acid, Caustic soda, Brines.

The pilot plant study was carried out and a two-stage electrodialysis process was developed for treatment of industrial waste waters containing sodium sulfate, which guarantees utilization of acid, alkali and reclaimed water. The dialysates are obtained with a salt concentration 2 g/l (90% from feed solution) and the brines with a salt content 260-320 g/l on the first stage during desalination in a multicompartment electrodialyzer from the solutions, which contained about 20-40 g/l of sodium sulfate. Solutions of sulfuric acid and caustic soda with concentration 17-19% by weight are manufactured at the second stage in three-compartment electrodialysis stack from the brine. The highly selective membranes guarantee the content of sodium sulfate in both products less than 1%. (Author's abstract)
W84-02151

DYNAMIC MEMBRANE ULTRAFILTRATION AND HYPERFILTRATION FOR THE TREATMENT OF INDUSTRIAL EFFLUENTS FOR WATER REUSE,
Memphis-Shelby County Human Services Partnership Project, TN.
G. R. Groves, C. A. Buckley, J. M. Cox, A. Kirk, and C. D. Macmillan.
Desalination, Vol. 47, p 305-312, May, 983. 4 Fig, 7 Ref.

Descriptors: *Membrane processes, *Wastewater treatment, Water reuse, Membranes, Ultrafiltration, Reverse osmosis, Hyperfiltration.

The treatment of high strength, highly fouling or hot industrial effluents by conventional membrane technology is difficult. Dynamic membranes are very versatile and have the major advantage of being replaceable in situ. The versatility of dynamic membrane technology is demonstrated. Both the ultrafiltration and reverse osmosis types of technology have several important advantages over conventional membranes for these types of applications. The low to medium salt rejection ultrafiltration dynamic membrane is useful particularly for water recycle applications where limited control of salt build-up is required. The capital cost of dynamic membrane modules is similar to that for thin-film composite tubular reverse osmosis modules. With their inherent advantage of higher membrane fluxes and ability to process both fouling and hot industrial effluents, the economics for certain applications may be favorable. (Baker-IVI)
W84-02156

DESALINATION AND REUSE OF INDUSTRIAL WASTE WATER BY ELECTRODIALYSIS,
Asahi Glass Co. Ltd., Yokohama (Japan). Research Lab.
K. Sato, S. Kobayashi, and S. Okado.
Desalination, Vol. 47, p 363-373, May, 1983. 7 Fig, 4 Tab.

Descriptors: *Electrodialysis, *Wastewater renovation, *Desalination, Industrial wastewater, Wastewater treatment, Water reuse, Pretreatment, Suspended solids, Filtration, Costs, Cooling water, Glass industry.

An economical desalination system for industrial waste water reuse has been developed using electrodialysis. The system consists of pretreatment and electrodialysis sections. With a conventional pretreatment of feed water through a sand filter, an increase of pressure drop in an electrodialyzer and also a decrease of performance of ion-exchange membranes occurred. They resulted from a deposition of suspended solids in a feed water on membranes. A new pretreatment method has been developed by a dual media sand filtration with addition of small quantity of ferric chloride and sodium hypochlolite into a feed water. In a pilot test with a capacity of 0.7 cu m/day, the new pretreatment process was verified to be effective for removing suspended solids below 0.1 ppm, which was corresponded to plugging index (P.I.) below 50%, and it was also proved that the increase of pressure drop in the electrodialyzer was suppressed with the feed of the filtrate. Based on these results, a commercial plant with a capacity of 400 cu m/day was constructed for desalting cooling waste water from a glassware manufacturing plant containing TDS of 500-1000 ppm and 1 - 2 ppm colloidal suspended solids. Since August 1980, the system has been operated successfully with little increase of pressure drop of the electrodialyzers. The power consumption of desalination was 0.15 KWH-DC/cu m-water and the running cost was estimated to be about 33 yen/cu m in case of power cost of 15 yen/KWH. (Author's abstract)
W84-02157

DENITRIFICATION WITH METHANOL; FUNDAMENTAL STUDY OF THE GROWTH AND DENITRIFICATION CAPACITY OF HYPHOMICROBIUM SP.,
Louvain Univ. (Belgium). Inst. voor Industriele Scheikunde.
P. Timmermans, and A. Van Haute.
Water Research, Vol. 17, No. 10, p 1249-1255, 1983. 8 Fig, 6 Tab, 16 Ref.

Descriptors: *Biological wastewater treatment, *Denitrification, *Hyphomicrobium, Nitrification, Methanol, Hydrogen ion concentration, Temperature, Nitrates, Nitrites, Wastewater treatment.

Hyphomicrobium sp. were found as dominant organisms in a two-sludge nitrifying denitrifying wastewater treatment system with methanol as external carbon source. The optimal pH for growth was found to be 8.3 and the organisms seemed to be rather temperature sensitive (Q10 = 3.3). The denitrification rate was expressed as a function of pH and temperature since it was almost independent on the concentrations of methanol and nitrate nitrogen. Identical growth rates are found when using either nitrate- or nitrite-nitrogen; the nitrite consumption rate, however, is twice the nitrate reduction rate. Nitrate to nitrite reduction is the rate limiting step in denitrification reaction and some inhibition by high concentrations of nitrite on the nitrate reduction is measured. The methanol/nitrate N ratio is 2.55 and increasing to 3.5 at extreme pH values. The endogenous denitrification rate is only 10% of the normal denitrification rate measured. (Author's abstract)
W84-02178

NITROGEN REMOVAL IN AERATED LAGOONS,
Clemson Univ., SC. Dept. of Agricultural Engineering.
E. J. Middlebrooks, and A. Pano.
Water Research, Vol. 17, No. 10, p 1369-1378, 1983. 8 Fig, 2 Tab, 12 Ref.

Descriptors: *Wastewater lagoons, *Nitrogen removal, Aerated lagoons, Mathematical models, Hydraulic models, Plug flow, Mixing, Dispersed flow, Kinetics, Detention time.

Rational and empirical models of ammonia nitrogen and total Kjeldahl nitrogen (TKN) removals were evaluated as a means of developing design relationships that can be used to estimate nitrogen removal in aerated wastewater lagoons. Plug flow, complete mix and dispersed flow hydraulic models were evaluated in conjunction with Monod growth kinetics, first order kinetics, and multiple substrate limiting relations. Polynomial equations, and multiple regression analyses were also tried. Combinations of the models were evaluated using field data from five aerated lagoon systems operating in various geographical areas of the USA. Only the plug flow model, assuming first order kinetics, of the classical approaches to biological modeling produced satisfactory results. Because of the simplicity of the plug flow model and a model based on the relationship between the fraction of nitrogen removed and the hydraulic detention time, it was recommended that these two equations be used to estimate nitrogen removal in aerated lagoons. (Author's abstract)
W84-02187

OZONATION OF WATER CONTAINING CHLORINE OR CHLORAMINES; REACTION PRODUCTS AND KINETICS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
W. R. Haag, and J. Hoigne.
Water Research, Vol. 17, No. 10, p 1397-1402, 1983. 4 Fig, 2 Tab, 21 Ref.

Descriptors: *Water treatment, *Disinfection, *Chemical reactions, Ozonation, Ozone, Chlorination, Chlorine, Chloramines, Kinetics, Drinking water, Oxidants.

When ozone and chlorine are applied in combination during water treatment, a direct reaction occurs which consumes both oxidants. This may be helpful for the treatment of wastewaters by using ozone to destroy toxic chlorine or chloramine before discharge into the receiving waters. However, this reaction can also reduce the efficiency of drinking water treatment, if ozonation is followed directly by chlorination or ozonation succeeds chlorination. Ozone reacts with aqueous chlorine at pH greater than 8 with a second order rate constant of 120/M/s at 20 degrees C. In the presence of 1 mg/l of chlorine at pH 8 this corresponds to an ozone half like of about 10 min. The ozonation products of aqueous chlorine are 77% chloride ion and 23% ClO3(-), independent of pH. No ClO4(-) is formed. Because of the low yield of ClO3(-) from chlorine, large amounts of toxic ClO3(-) are not expected to be produced by the ozone-chlorine reaction at a waterwork. The effect of ammonia, via formation of monochloramine, is to decrease the rate constant for ozone consumption to a pH-independent 26/M/s. The products of NH2Cl ozonation are NO3(-) and Cl(-), but not ClO3(-). Reaction of chlorine with ozone accounts for the bulk of the additional chlorine and ozone demand found when the two oxidants are used simultaneously and thus explains to a large degree the interference in the disinfection process. (Baker-IVI)
W84-02190

EFFECT OF SOLUTE COMPETITION ON OZONOLYSIS OF INDUSTRIAL DYES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
F. M. Saunders, J. P. Gould, and C. R. Southerland.
Water Research, Vol. 17, No. 10, p 1407-1419, 1983. 19 Fig, 6 Tab, 34 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Dye industry wastes, Solutes, Ozone, Oxidation, Dyes.

Ozonation of three industrial dyes was examined in batch studies with single- and multi-solute dye solutions. The kinetics of dye oxidation were controlled by gas transfer limitations and oxidation took place at the gas-liquid interface. Competition by dye molecules for the gas-liquid interface and relative chemical reactivity resulted in the preferential oxidation of selected dyes in mixtures of three dyes and auxilliary compounds typically found in dye-bath wastewaters. These findings suggest that surface-active properties of wastewater contaminants may be as important as their chemical reactivity in determining the overall fate of contaminants during ozonation. Ozonation of wastewater samples in a laboratory scale heterogeneous gas flow system may not be indicative of the

results that would be obtained in full-scale reactor system if the ozone transfer characteristics of the two systems are significantly different. If the preferential oxidation of compounds at a gas-liquid interface was decreased in overall importance by enhanced ozone transer and accumulation of a residual ozone concentration in solution, then the sequence of compound oxidation and resulting oxidation-product distributions would be potentially altered. Increased ozone requirements could result if significant oxidation of contaminants other than target compounds was achieved concurrently with the oxidation of the target compounds. (Baker-IVI)
W84-02191

EVALUATION OF ALTERNATIVE SLUDGE SETTLEABILITY INDICES,
Merck and Co., Inc., Rahway, NJ.
S.-E. Lee, B. Koopman, H. Bode, and D. Jenkins.
Water Research, Vol. 17, No. 10, p 1421-1426, 1983. 10 Fig, 2 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Activated sludge process, Sludge, Suspended solids, Sludge volume index, Settling, Sludge thickening, Water pollution control, Clarifiers, Clarification.

The unpredictable effect of suspended solids (SS) concentration on the standard solids volume index (SVI) is widely recognized. Five modifications of the SVI test were evaulated in attempts to overcome this problem. The five different indices tested were diluted SVI, SVI annd SS concentrations of 1.5, 2.4, and 3.5 g/l, and stirred SVI at 2.5 g/l. The closest and most consistent correlation with filamentous organisms content was the diluted SVI modification. Its consistent behavior derives from always having the compact volume of the settled sludge measured after the compression phase of settling is reached. Convenience is preserved in this modification by diluting the sludge so that the compression phase of settling is reached within a 30-min period. Other advantages of this test include a wider range of settleabilities over which sludges may be characterized and applicability to bench scale units as well as to prototype scale plants in terms of the quantity and concentration of sludge required to perform the test. Correlation of the diluted SVI with specific functional relationships between settling velocity and SS concentration would enable the application of this parameter to prediction of thickening capacity in secondary clarifiers. (Baker-IVI)
W84-02192

PREDICTION OF THICKENING CAPACITY USING DILUTED SLUDGE VOLUME INDEX,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
B. Koopman, and K. Cadee.
Water Research, Vol. 17, No. 10, p 1427-1431, 1983. 8 Fig, 1 Tab, 8 Ref. Univ. of Florida Grant 124516191.

Descriptors: *Wastewater treatment, *Activated sludge process, *Sludge thickening, Water pollution control, Secondary wastewater treatment, Sludge volume index, Clarifiers, Biological wastewater treatment.

Knowledge of the secondary clarifier's capacity to produce an adequately thickened underflow stream is essential for successful design and control of the activated sludge process. How sludge settleability, as characterized by diluted sludge volume index (SVI*) can be factored into thickening capacity calculations is demonstrated. From considering of published data relating activated sludge settling velocity to filament content and suspended solids concentration and SVI* to filament content it was shown that parameters characterizing activated sludge settling properties were consistently related to SVI*. These correlations were used in conjunction with settling flux theory to demonstrate limiting solids loading plotted as a function of SVI* and underflow velocity. Applications of this information include determination of limiting solids loading, minimum underflow velocity, return sludge pumping capacity, and maximum possible mixed liquor suspended solids concentration. (Baker-IVI)
W84-02193

PREDICTIVE MODEL FOR TREATMENT OF PHENOLIC WASTES BY ACTIVATED SLUDGE,
Delaware Univ., Newark. Dept. of Civil Engineering.
A. F. Rozich, A. F. Gaudy, Jr., and P. D. D'Adamo.
Water Research, Vol. 17, No. 10, p 1453-1466, 1983. 8 Fig, 9 Tab, 28 Ref. OWRT project A-051-DEL.

Descriptors: *Wastewater treatment, *Activated sludge processes, *Phenols, Industrial wastes, Model studies, Monod equation, Haldane equation, Oxygen demand, Kinetics.

A kinetic model for activated sludge treating inhibitory wastes has been devised and tested experimentally using phenol as inhibitory carbon source. The model employs the Haldane equation as the functional relationship between specific growth rate, and exogenous substrate concentration and utilizes control of recycle sludge concentration as a major selectable engineering control parameter of net specific growth rate. Predictions of process performance were made using the model equations and the five biokinetic constants determined from the pilot plant data and from separate batch growth experiments. The model adequately predicted reactor biomass concentration, waste sludge production and effluent COD concentration. The model predicted specific phenol concentrations in the reactor effluent significantly higher than the observed experimental values. The results of the growth studies clearly indicate that the Monod equation was note generally applicable to phenol. Also, dilute-out curves computed using the biokinetic constants, recycle sludge concentration and recycle flow rate employed in the pilot plant studies clearly showed that the two approaches (Haldane and Monod) predict radically different results as dilution rate increases. At high concentration levels of the substrate in inflowing feed to the biological reactor the inhibitor model clearly indicated system failure at dilution rates significantly lower than predicted by the Monod model. The use of a Monod function in the mass balance equations gives both the design engineer and the operator a distorted view of the true operating range of the system and does not alert one to the existence of a critical operating point for an activated sludge process treating inhibitory carbon sources. (Baker-IVI)
W84-02196

EFFECT OF SANITATION EFFORTS ON THE MANGANESE CYCLE IN LAKE CONSTANCE (OBERSEE AND UNTERSEE-GNADENSEE) (DIE AUSWIRKUNGEN VON SANIERUNG-MASSNAHMEN AUF DEN MANGANHAUSHALT DES BODENSEES (OBERSEE UND UNTERSEE-GNADENSEE)),
Landesansalt fur Umweltschutz Baden-Wuettemberg, Langenargen (Germany, F.R.). Inst. fur Seenforschung und Fishereiwesen.
For primary bibliographic entry see Field 5C.
W84-02242

REMOVAL AND INACTIVATION OF VIRUSES BY TREATMENT PROCESSES FOR POTABLE WATER AND WASTEWATER-A REVIEW,
Montgomery (James M.), Inc., Pasadena, CA.
L. Y. C. Leong.
Water Science and Technology, Vol. 15, No. 5, p 91-114, 1983. 15 Tab.

Descriptors: *Viruses, *Bacteriophage, *Wastewater treatment, *Water treatment, *Water reuse, Disinfection, Potable water, Chlorination, Wastewater renovation, Public health.

Due to increasing urbanization, developing economical uncontaminated water sources is becoming more difficult. The resultant increase of indirect reuse and proposed and operating reuse projects raise questions concerning the public health hazard from waterborne viruses. A review of the fate of enteric viruses and phages through each major unit process used in wastewater and potable water treatment is given. Starting out with raw sewages, optimized conventional tertiary wastewater treatment with one hour contact and free chlorine residuals can be expected to remove 5-7 logs of viruses leaving <1 infectious unit/1000 liters. The most consistent and conservative potable water treatment designs dictate that one relies on good water resources and utilizes renovated waters in manners which give the least direst exposure to the public. Dilution, indirect reuse, or additional treatment are the suggested approaches until more research is conducted. This would minimize the public health problems and provide a buffer for viruses and other contaminants which have yet to be detected and identified or for those which may occasionally break through the treatment train. It is difficult to design and operate a failsafe drinking water plant. Therefore, direct reuse should be utilized for short periods of time or under special circumstances. (Moore-IVI)
W84-02262

EVALUATION OF THE LOAD OF ENTEROVIRUSES IN A BIOLOGICAL WASTEWATER TREATMENT PLANT,
Laboratoire d'Hygiene et de Recherche en Sante Publique, Vandoeuvre Les Nancy (France). Faculte de Medecine.
D. Rolland, Ph. Hartemann, J. C. Joret, A. Hassen, and J. M. Foliguet.
Water Science and Technology, Vol. 15, No, 5, p 115-121, 1983. 1 Fig, 4 Tab, 17 Ref.

Descriptors: *Enteroviruses, *Biological wastewater treatment, *Activated sludge process, Sampling, Automation, Bacteria, Indicators, Wastewater treatment, Nancy, France.

The numbers of enteroviruses, classical bacterial indicators and physicochemical parameters were recorded for raw and treated wastewaters from the Nancy (France) activated sludge treatment plant, over 24 and 72 hours periods. Sampling was performed manually by collection of 2 and 3 hour interval dip samples and by sequential automatic samplers. The results obtained with both methods are in good agreement; 24 hours composite samples with automatic sampling are representative of enteroviruses flux and thus allow studies of the efficiency of removal treatments. According to both sampling methods, the efficiency of the Nancy wastewater treatment plant is about 84% for the removal of indigenous enteric viruses. (Author's abstract)
W84-02263

VIROLOGICAL STUDY OF DRINKING AND WASTEWATER DISINFECTION BY OZONATION,
Laboatoire d'Hygiene et de Recherche en Sante Publique, Vandoeuvre les Nancy (France). Faculte de Medecine.
For primary bibliographic entry see Field 5F.
W84-02266

BIOMETHANATION BY IMMOBILISED FLUIDISED CELLS,
Louvain Univ. (Belgium). Unit of Bioengineering.
R. A. Binot, T. Bol, H.-P. Naveau, and E.-J. Nyns.
Water Science and Technology, Vol. 15, No. 8/9, p 103-115, 1983. 3 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Fluidized beds, Anaerobic conditions, Industrial wastes, Bacteria, Biomethanation.

High loading rates and high conversion rates can be obtained in biomethanation of industrial wastewaters by accumulating active biomass in anaerobic reactors. A particular technique of active biomass accumulation, using cell immobilization on inert solid support particles fluidized in an upflow reactor, is presented. The results obtained in a lab-scale reactor of 0.5 l total volume, using spent liquor from citric acid fermentation, are good. Volumetric loads up to 42,000 mg COD/l reactor/day with more than 70% conversion are reached under steady state conditions and volumetric load increases of 10% per day with stable conversion are feasible during transition steps.

Loading and conversion rates are drastically higher in immobilized fluidized cell systems than in conventional completely mixed systems, with similar food to microorganism ratios and gas production rates per active biomass unit in the reactor. These performances are directly related to the accumulation of active biomass, including methanogenic bacteria, in immobilized fluidized cells reactors. A more qualitative approach is used to compare the immobilized fluidized cell technique with other active biomass accumulation techniques. (Baker-IVI)
W84-02285

ANAEROBIC FILTER TREATMENT OF MOLASSES FERMENTATION WASTEWATER,
Universidade Nova de Lisboa, (Portugal). Dept. of Environmental and Earth Science.
M. J. T. Carrondo, J. M. C. Silva, M. I. I. Figueira, R. M. B. Ganho, and J. F. S. Oliveira.
Water Science and Technology, Vol. 15, No. 8/9, p 117-126, 1983. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Food-processing wastes, *Filtration, Anaerobic conditions, Fermentation, Sulfides, Hydrogen sulfide, Wastewater treatment.

Two anaerobic filters were used to assess the treatability of a high strength acidic molasses fermentation wastewater containing up to 3000 mg/l of sulfate ion. The waste had to be neutralized and buffered prior to treatment and the filters operated at ambient temperature. The inlet COD concentrations were increased from 10,000 to 50,000 mg/l, organic loads ranged from 2 to 12 kg COD/cu m per day at hydraulic retention times of 2.5 and 5 days. COD removals varied from 57 to 79% and removal rates as high as 6.8 kg COD/cu m per day were obtained. Although the gas productions were reasonable, the methane content was always lower than 40%. Anaerobic filters appear to be good for pretreatment purposes and the gas produced may be used for burning with some caution due to high sulfide concentrations. Alternatively, the sulfide might be precipitated or scrubbed off. Although the alkalinity gains are small, it is probably important to recycle the effluent to decrease the costs associated with the chemicals used for neutralizing the influent. The use of two filters in series might further improve the treatment results. The filters were operated for seven months without sludge removal. (Baker-IVI)
W84-02286

INDUSTRIAL WASTEWATER TREATMENT USING ANAEROBIC FLUIDIZED BED REACTORS,
Ecolotrol, Inc., Bethpage, NY.
J. S. Jeris.
Water Science and Technology, Vol. 15, No. 8/9, p 169-176, 1983. 5 Fig, 4 Tab, 4 Ref.

Descriptors: *Wastewater treatment, *Fluidized beds, Anaerobic conditions, Industrial wastes, Methane, Energy, Activated sludge process, Biological wastewater treatment.

Pilot plant results of anaerobic treatment using granular biological fluidized bed treatment for a number of industrial wastes are presented. Wastes containing from 5,000 to 54,000 mg/l were treated with 65 to 95% COD removal in 0.3 to 4.9 days hydraulic detention time. Organic loadings of 3 to 38 kg COD/cu m per day were used. Typically 0.4 l methane were produced per gram of COD removed at 35 degrees C. Methane averaged close to 70% with a range between 65 and 75%. An estimate is given of a simplified energy comparison of anaerobic versus aerobic treatment for a wastewater flow of 100,000 gpd with 5,000 mg/l COD retention and due to the methane generation a net energy production of 2,300 kwh/day is indicated anaerobically versus a net energy use of 600 to 900 kwh/day for the aerobic system. (Baker-IVI)
W84-02287

DESIGN OPERATION AND ECONOMY OF ANAEROBIC TREATMENT,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
G. Lettinga, S. W. Hobma, L. W. Hulshoff Pol, W. de Zeeuw, and P. de Jong.
Water Science and Technology, Vol. 15, No. 8/9, p 177-195, 1983. 6 Fig, 6 Tab, 35 Ref.

Descriptors: *Wastewater treatment, *Anaerobic conditions, Activated sludge processes, Filtration, Films.

A more optimal design and operation of a high rate anaerobic waste water treatment process was sought. The discussion is based on available information on modern anaerobic waste water treatment processes, such as the anaerobic filter process and the upflow anaerobic sludge blanket process and of the recently introduced attached film processes. In upflow anaerobic waste treatment processes the presence of packing material in the anaerobic reactor may be beneficial for reducing the washout of suspended matter, but it does not improve the loading potentials of the process due to clogging, shortcircuiting and/or poor contact between the sludge and the waste water that prevails. A prerequisite for using such a process is that a dense, and preferable a granular, type of sludge develop in the anaerobic reactor on the waste water submitted to the treatment process. Once the anaerobic process can be satisfactorily immobilized, high organic and hydraulic loads can be theoretically applied. However, in all cases, the reactor should be equipped with a gas-solids separator. (Baker-IVI)
W84-02288

MATHEMATICAL MODELING OF THE ANAEROBIC FILTER PROCESS,
Royal Inst. of Technology, Stockholm (Sweden). Center for Environmental Sciences.
M. Lindgren.
Water Science and Technology, Vol. 15, No. 8/9, p 197-207, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Mathematical models, *Filtration, *Anaerobic conditions, Wastewater treatment, Biological treatment, Model studies, Monod kinetics, Kinetics, Simulation.

A dilute synthetic wastewater was anaerobically treated in a filter. A relatively complex mathematical model describing the anaerobic degradation of organic carbon and nitrogen in anaerobic filters, as a two-step process, adequately simulates steady state data. The model is based on Monod-kinetics incorporating a pH inhibition function but neglecting solids transport and biofilm diffusion. The model accurately describes the chemical interactions occurring in the filter among nitrogen, volatile acids, carbon dioxide, alkalinity and pH and is very useful for system understanding. A simplified model based on first and zero order kinetics and separate biosolid fractions also adequately simulates steady-state data. This model may be further simplified and is more readily usable for dynamic system analysis, optimization and design. (Baker-IVI)
W84-02289

ANAEROBIC WASTE WATER TREATMENT IN A CARRIER ASSISTED SLUDGE BED REACTOR,
AB Sorigona, Staffanstorp, (Sweden).
L. Martensson, and B. Frostell.
Water Science and Technology, Vol. 15, No. 8/9, p 233-246, 1983. 9 Fig, 5 Tab, 7 Ref.

Descriptors: *Wastewater treatment, *Sludge bed reactor, Food-processing wastes, Anaerobic conditions, Activated sludge process.

A 40 l tank reactor, filled to 3% (v/v) with a small size (5-25 micrometer) carrier material and equipped with a mechanical mixer, was used to create a sludge bed system for anaerobic wastewater treatment. Solids leaving the tank with the effluent were recycled to the tank from an external settler. Two different substrates were used, fodder molasses diluted with tap water and beet sugar factory wastewater. Influent concentrations were 9.3 g COD/l and 4-7 g COD/l respectively, and treatment was performed at 35-37 degrees C. With the synthetic molasses waste water, an organic load of 5-6 kg COD/cu m/day could be tolerated; with the sugar industry waste water, 25 kg COD. The difference in loading capacity was ascribed to different types of sludges formed, the molasses waste water resulting in a much more bulky sludge and a lower attainable volatile suspended solids concentration. Much care must be exercised before designing sludge bed systems for high loads with unhydrolyzed waste waters. With the sugar industry wastewater, a food-to-mass ratio of 1.3 kg COD/kg VSS/day resulted in an efficient treatment. For the molasses substrate, problems were encountered at food-to-mass ratios exceeding 0.5-0.7 kg COD/kg VSS/day. Sludge bed reactors seem to have their greatest potential for hydrolyzed wastewaters. (Baker-IVI)
W84-02290

ANAEROBIC TREATMENT OF A BLACK LIQUOR EVAPORATOR CONDENSATE FROM A KRAFT MILL IN THREE TYPES OF FIXED-FILM REACTORS,
Swedish Water and Air Pollution Research Lab., Stockholm.
J. Norrman.
Water Science and Technology, Vol. 15, No. 8/9, p 247-259, 1983. 9 Fig, 4 Tab, 9 Ref.

Descriptors: *Anaerobic digestion, *Kraft mills, *Pulp wastes, Wastewater treatment, Methane, Sulfates, Pulp and paper industry, Industrial wastes.

A black liquor evaporator condensate from a kraft mill was anaerobically treated in a fixed bed reactor (= an anaerobic filter), an expanded bed and a fluidized bed. The condensate treated in the fixed bed reactor and the expanded bed had an average COD concentration of 1.4 kg/cu m. Before treatment in the fluidized bed the condensate was diluted to 0.42. Efficient purification (80 % COD reduction or better) was obtained at volumetric loads up to 2 kg COD in the fixed bed reactor, 10 kg COD/cu m/d in the expanded bed and 13 kg COD/cu m per day in the fluidized bed. Two of the reactors were operated at room temperature. When the temperature dropped below 20 degrees C gas production was inhibited. The specific methane production was 0.10-0.30 cu m/kg COD added in the fixed bed reactor, 0.07-0.15 cu m/kg COD added in the expanded bed and 0.07-0.20 cu m/kg COD added in the fluidized bed. Process stability was high in both the fluidized bed and the fixed bed reactor, but sand and biomass were intermittantly lost from the expanded bed. (Baker-IVI)
W84-02291

ATTACHED VERSUS SUSPENDED GROWTH ANAEROBIC REACTORS: RESPONSE TO TOXIC SUBSTANCES,
Drexel Univ., Philadelphia, PA.
G. F. Parkin, and R. E. Speece.
Water Science and Technology, Vol. 15, No. 8/9, p 261-289, 1983. 18 Fig, 4 Tab, 27 Ref. DOE contract EC-77-S-02-4391, USAF contract F-49620-79-C0190, NSF contract NSF-ENG-79-07993.

Descriptors: *Anaerobic digestion, *Methane fermentation, Cyanide, Chloroform, Formaldehyde, Ammonia, Fermentation, Methane, Industrial wastes, Toxicity, Nickel, Sulfides, Energy, Methanogens, Wastewater treatment.

Anaerobic methane fermentation has significant potential for treatment of industrial wastewaters. Application of the process has been limited, due in part to the belief that the process cannot tolerate chronic and transient toxicity inherent in many industrial wastewaters. A comparison was made of the response to transient and chronic toxicity of suspended and attached growth reactors. Experiments with cyanide, chloroform, formaldehyde, ammonium, nickel and sulfide have shown that the methanogens have the ability to recover from and acclimate to relatively high concentrations of toxicants and that prolonged periods of zero gas production are not indicative of actual or eventual

process failure. The key is proper attention to solids retention time. Of the two general reactor types used in biological waste treatment, attached growth systems offer two major potential advantages over suspended growth systems for treating wastewaters containing toxicants: higher inherent solids retention times at relatively low hydraulic retention times and the potential for a quasi plug-flow hydraulic regime that allows rapid elution of toxicants. For transient toxicity, the ability of a plug-flow, attached growth systems to rapidly elute toxicants resulted in dramatically reduced down times when compared to a complete-mix, suspended growth system. For chronic toxicity, the solids retention capability of attached growth systems allows for acclimation to occur prior to washout of active biomass. Effluent recycle to plug-flow, attached growth systems should allow for more gradual exposure to chronic toxicity, thus maximizing acclimation potential. (Baker-IVI)
W84-02292

DISTURBANCE OF SAND FILTER SUPPORTING LAYERS BY AIR SCOURING,
Geustyn Forsyth and Joubert, Inc., Pretoria (South Africa).
J. Haarhuff, and W. M. Malan.
Water South Africa, Vol. 9, No. 2, p 41-48, April, 1983. 5 Fig, 6 Ref.

Descriptors: *Sand filters, *Air scouring, *Backwash, Gravel, Design criteria, Cleaning.

The backwashing of rapid sand filters and in particular the method whereby the filter bed is subjected to a period of scouring with air alone before the impurities are flushed from the bed with a low velocity backwash, is reviewed. This widely used method displayed the potential to disturb the gravel layers on which the sand is supported if the air scour rate exceeds a certain value. Experimental work is reported which indicates when, how and under which circumstances the gravel particles intermix with the sand. At an equivalent air scour rate of 8.7 mm/s a few gravel particles at the top of the fine gravel layer were just lifted in the sand above as the first burst of air rose through the bed. Preliminary design parameters are proposed to prevent the intermixing of sand and gravel. The serious consequences of this intermixing are outlined and a few of the many possible solutions are briefly evaluated including abolition of the sand supporting layers, keeping the design air scour rate below the critical value, using a reduced air scour rate at the start of the air scour cycle and using double reverse gravel grading. (Baker-IVI)
W84-02303

TRACE METAL SURVEYS IN MOSSEL BAY, ST. FRANCIS BAY AND ALGOA BAY, SOUTH AFRICA,
Port Elizabeth Univ. (South Africa). Dept. of Zoology.
R. J. Watling, and H. R. Watling.
Water South Africa, Vol. 9, No. 2, p 57-65, 1983. 1 Fig, 3 Tab, 19 Ref.

Descriptors: *Trace metals, *Coastal waters, South Africa, Papenkuils River, Cape Recife, Mossel Bay, St. Francis Bay, Algoa Bay, Swartkops River, Monitoring, Water pollution.

Surveys to determine trace-metal levels in Mossel Bay, St. Francis Bay and Algoa Bay were undertaken during 1978-1979. Water, sediment and biological samples were analysed for up to 16 elements by atomic absorption spectrophotometry. Metal concentrations are low along the entire Mossel Bay coast and no significant sources of metal pollution were discovered. Some variations in concentrations occur but these are often due to catchment mineralization and, in any case, are only slightly elevated above background levels. St. Francis Bay is unpolluted with respect to metals, the levels of which are generally lower than those found in equivalent samples from Algoa Bay. The Swartkops and Papenkuils Rivers and the Cape Recife sewer outfall contribute considerable amounts of metals to Algoa Bay. However, with the exception of the Papenkuils River, these amounts are too small to cause significant environmental stress to the Algoa Bay ecosystem. The diverse fauna and flora of the bay are indicative of an unpolluted environment. (Author's Abstract)
W84-02305

APPLICATION OF A TETRAHYMENA PYRIFORMIS BIOASSAY SYSTEM FOR THE RAPID DETECTION OF TOXIC SUBSTANCES IN WASTEWATERS,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W84-02307

GENERALIZED MODEL OF AEROBIC BIOLOGICAL TREATMENT,
V. A. Vavilin.
Water Resources, Vol. 9, No. 4, p 416-427, July-August 1982. 7 Fig, 2 Tab, 23 Ref. Translated from Vodnye Resursy, No. 4, p 136-148 July-August 1982.

Descriptors: *Wastewater treatment, *Aerobic treatment, *Biological wastewater treatment, Model studies, Aeration, Chemical oxygen demand, Biochemical oxygen demand.

A generalized model of the process of aerobic biological treatment, regardless of the type of reactor (aeration tank, biofilter or biodisk), is proposed, based on the following main principles. Reactors accomplishing the process of aerobic biological treatment rework a certain spectrum of substrates-pollutants which represent individual components of a multicomponent pollutant. The rate of treatment depends on the rate of oxidation of individual components and contribution of these rates to the total rate of oxidation, determined by the concentration of components. The main variable determining the law obeyed by the treatment process is the concentration of pollutant in the effluent. For most variations in the effluent pollutant concentration, generalized models of the treatment process are adequate for experiments. The type of reactor as a first approximation is not significant when treating multicomponent wastewaters, since during treatment 0-th order reactions play the dominant role during oxidation of individual components of the multicomponent pollutant. (Baker-IVI)
W84-02325

HYDRODYNAMICS OF TWO-PHASE COCURRENT DOWNFLOW THROUGH PACKED BEDS; PART I. MACROSCOPIC MODEL, PART II. EXPERIMENT AND CORRELATIONS,
Indian Inst. of Tech., Madras. Dept. of Chemical Engineering.
V. G. Rao, M. S. Ananth, and Y. B. G. Varma.
Journal of Hydrology, Vol. 29, No. 3, p 467-483, May, 1983. 23 Fig, 1 Tab, 46 Ref.

Descriptors: *Packed beds, *Pressure distribution, Hydrodynamics, Model studies, Bubbles, Wastewater treatment, Design criteria.

Pressure drop and liquid saturation are two important design parameters in cocurrent gas-liquid downflow through packed beds. A macroscopic model based on momentum balance is formulated for the condition of no radial pressure gradients. The formulation is generalized, the assumptions are explicity stated and an attempt has been made to take into account the interaction between the phases through bubble formation, breakage, and reformation. The model presents a logical framework for the inclusion of other dynamic interactions such as friction at the interface and entrainment and is therefore more comprehensive than earlier models. The model parameters are determined independently for each of the identified regions of flow. However, a priori values are provided for five parameters out of nine on physical grounds, as well as orders of magnitude values for the remaining four. Actual values for these four have to be determined by fitting experimental data to the theory. (Baker-IVI)
W84-02349

CARE AND FEEDING OF A CHEMICAL FEEDER,
R. J. Baker, and W. B. Heuber.
Water Engineering and Management, Vol. 130, No. 12, p 27-28 and 51, November, 1983.

Descriptors: *Chemical treatment, *Maintenance, Waste treatment, Water treatment, Training, Design criteria, Safety, Management.

There are five well defined areas of responsibility for the proper operation and maintenance of a chemical feed system for water or wastewater treatment: the manufacturer of the equipment, the engineer who designs the plant, the chemical supplier, the management of the plant, and the operator who runs the plant. The manufacturer must be able to provide good service and make the equipment correctly. The design engineer must ensure that his design accomodates the needs the system is to provide for and that it does so efficiently and effectively. The chemical supplier must ensure that his product meets the material specification consistently. Plant management must be committed to a permanent, comprehensive operations and maintenance program. The operator has to be trained to supply the operational and maintenance needs of the total system. Also needed are an efficient maintenance schedule, a spare parts inventory, a system for rotating the use of spare or standby equipment, a safety consciousness, and good housekeeping. (Baker-IVI)
W84-02367

EXPENSIVE DISCHARGES FROM CANNERY ROW,
SRI International, Menlo Park, CA. Chemical Engineering Lab.
J. L. Jones.
Water Engineering and Management, Vol. 130, No. 12, p 33-34 and 38, November, 1983. 4 Fig, 2 Tab.

Descriptors: *Canneries, *Wastewater treatment, *Economic aspects, Costs, Food processing wastes, Industrial wastes.

Charges by municipalities for the treatment of seasonal cannery wastewaters are determined by a number of factors, the important ones being the effluent limitations imposed on the treatment plant, the size of the canning season, biochemical oxygen demand, and suspended solids loads relative to the non-canning season loads, the total capacity of the treatment plant, and the treatment processes employed. The wastewater treatment problem has been particularly troublesome to the canning industry because of the magnitude of the waste load. The estimated annual charges for a typical cannery discharging to various municipal sewer systems indicates a sevenfold range in charges from a high of about $360,000 to a low of $50,000 ($3/1000 gal treated to $0.40/1000 gal treated). (Baker-IVI)
W84-02369

MASS BALANCE OF HEAVY METAL UPTAKE BY ENCAPSULATED CULTURES OF KLEBSIELLA AEROGENES,
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
T. Rudd, R. M. Sterritt, and J. N. Lester.
Microbial Ecology, Vol. 9, No. 3, p 261-272, 1983. 5 Fig, 1 Tab, 29 Ref.

Descriptors: *Klebsiella, *Heavy metals, *Activated sludge process, Polymers, Encapsulated cells, Mass balance, Wastewater treatment, Copper, Cadmium, Cobalt, Nickel, Manganese, Metals, Extracellular polymer.

Dialysis was employed as a method of speciating heavy metals in cultures of an extracellular polymer forming strain of Klebsiella aerogenes. A non-capsulated strain of the same bacterium was used as a control, and a mass balance of copper, cadmium, cobalt, nickel, and manganese in batch culture at pH 4.5 and pH 6.8 and in continuous culture at pH 6.8 was constructed. Copper and cadmium were accumulated by the cell during rapid proliferation whereas all 5 metals were bound nonspeci-

fically by extracellular polymer produced during stationary phase and at low dilution rates. The presence of extracellular polymer appeared to inhibit cellular uptake of nickel. At the lower pH, metal uptake was considerably reduced. Capsulated cells of K. aerogenes are capable of retaining greater concentrations of metals than an equivalent number of noncapsulated cells, and although only a fraction of some of the metals added was retained, in comparison to typical environmental concentrations such metal removals may be of considerable significance in the activated sludge process of sewage treatment. (Moore-IVI)
W84-02373

5E. Ultimate Disposal Of Wastes

REDUCTION OF NITRATE CONCENTRATION IN DRINKING WATER BY A HYBRID PROCESS WITH ZERO DISCHARGE BASED ON REVERSE OSMOSIS,
For primary bibliographic entry see Field 5F.
W84-02154

HYDRAULIC DELIQUORING OF COMPRESSIBLE FILTER CAKES. I. REVERSE FLOW IN FILTER PRESSES,
Houston Univ., TX. Dept. of Chemical-Petroleum Engineering.
F. M. Tiller, and L.-L. Horng.
AIChE Journal, Vol. 29, No. 2, p 297-305, March, 1983. 13 Fig, 2 Tab, 20 Ref.

Descriptors: *Dewatering, *Filtration, Porosity, Sludge drying, Sludge thickening, Filters, Wastewater treatment.

Deliquoring of filter cakes is an important operation in solid-liquid separation. Mechanical squeezing using membranes in filter presses requires additional investment in equipment and direct use of hydraulic pressure as developed by pumps represents the simplest method for porosity reduction. Reversing the direction of flow through the highly compressible bed leads to marked reduction in porosity. In filter presses, washing automatically leads to a reverse flow pattern. Failure to recognize the effects of hydraulic, reverse flow deliquoring can negate the practical advantage in an industrial filter. If the expressed liquid is not drained but is simply dumped along with the cake into a common receiver, the average liquid context will remain unchanged. Highly compressible cakes derived from wastewater are seldom washed to removed soluble substances. Therefore, presses used for such filtration must be modified to permit washing if hydraulic deliquoring is to be used. Theoretical calculations are shown for materials with differing characteristics. Experimental verification of the theory is provided for calcium carbonate, kaolin, attapulgite, and colloidal silica. The amount of liquid which could be expressed hydraulically varies from 10-60% of the amount remaining at the end of filtration. (Baker-IVI)
W84-02350

LEACHATE RECIRCULATION PROJECT,
Town of Brookhaven, Patchoque, NY. Division of Sanitation.
J. W. Pavacic.
Public Works, Vol. 114, No. 5, p 68-70, May, 1983. 2 Fig, 1 Tab, 1 Ref.

Descriptors: *Leachates, *Landfills, Wastewater treatment. Land application, Wastewater treatment facilities, Spray irrigation, Vegetation.

Leachate is currently being pumped from the Brookhaven (New York) landfill to be treated at the Southwest Sewer District's Bergen Point Treatment Plant at a rate of 120,000 gallons of leachate per week. An alternative method of leachate treatment was proposed which will employ recirculation of leachate at first on a small completed section of the landfill. Three experimental plots, each 50 by 50 ft. were devised, encompassing the broadest possible selection of plant species. Sprinkler heads applied about 6 gallons per minute of leachate pumped from a 48 inch wet well. Each plot was treated for 33 minutes, resulting in a total deposition of about 190 gallons per plot per day, an amount equivalent to the average annual rainfall of 45 inches. Odors were noted only in the immediate vicinity of the spray plots and only during the actual spraying process. By watching how the various plant species reacted to the spraying it is recommended that slopes used for this purpose be seeded with aster, quackgrass, and hydroseed mixes. Flat areas should be seeded with water tolerant plants such as smartweed and common reed. (Baker-IVI)
W84-02356

5F. Water Treatment and Quality Alteration

REDUCTION OF NITRATE CONCENTRATION IN DRINKING WATER BY A HYBRID PROCESS WITH ZERO DISCHARGE BASED ON REVERSE OSMOSIS,
G. van Opbergen, Th. Peters, R. Rautenbach, and H. Tils.
Desalination, Vol. 47, p 267-274, May, 1983. 2 Fig, 5 Ref.

Descriptors: *Nitrates, *Water treatment, *Reverse osmosis, Drinking water, Ion exchange, Electrodialysis, Thin-film evaporation, Brine disposal.

As a consequence of the heavy utilization of artificial fertilizers, the nitrate concentration of certain well waters has increased to figures above the standards set by the German Federal authorities. If such well water cannot be diluted by corresponding amounts of nitrate-free-water, the nitrate has to be removed, at least partially. In principle, reverse osmosis is capable of reducing the nitrate concentration. There will be however a brine with high nitrate content amounting to about 10% of the feed flow which cannot be discharged into a river or a deep well. This paper discusses a hybrid process based on reverse osmosis which solves the problem of the concentrate-disposal by treating this concentrate in a zero discharge system utilizing selective ion-exchange, electrodialysis and thin-film-evaporation. A pilot-plant with a capacity of 50 cu m/d permeate is under construction on the premises of a municipal waterworks. Special factors of interest are the reliability as well as the actual costs of such a process, the possibility of utilizing brine for the regeneration of the ion-exchanger and the optimal concentration factors for every step of the process. (Author's abstract)
W84-02154

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES - V; PROCESS DEVELOPMENT,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
N. J. Anderson, and A. J. Priestley.
Water Research, Vol. 17, No. 10, p 1227-1233, 1983. 4 Fig, 6 Tab, 4 Ref.

Descriptors: *Water treatment, *Coagulation, *Magnitite, Turbidity, Color, Potable water, Caustic soda.

A process design has been developed for a continuous process to clarify turbid and colored waters with alkali treated magnetite. The magnitite, when pretreated with 200 ml of 0.1 M NaOH per 10 ml of wet magnitite slurry and washed with tap water, is capable of removing turbidity and color from river water to meet potable water standards. The design avoids the use of a filtration step and, because the equipment required for the plant is both conventional and commercially available, the process appears to be technically feasible. Critical parts of the process have been investigated in small bench scale equipment, and criteria determined for the proper selection of equipment. The caustic soda requirement has been reduced to a relatively low level, and the wash water requirement reduced to about 4% of the plant throughput. While this gives the process a good chance of being economically viable, a more accurate answer to the economic question will be given by the long term operation of a larger pilot plant. (Moore-IVI)
W84-02176

COLOUR AND TURBIDITY REMOVAL WITH REUSABLE MAGNETITE PARTICLES - VI; PILOT PLANT OPERATION,
Commonwealth Scientific and Industrial Research Organization, South Melbourne (Australia). Div. of Chemical Technology.
N. J. Anderson, B. A. Bolto, N. V. Blesing, L. O. Kolarik, and A. J. Priestley.
Water Research, Vol. 17, No. 10, p 1235-1243, 1983. 6 Fig, 6 Tab, 2 Ref.

Descriptors: *Water treatment, *Coagulation, *Magnitite, Color, Turbidity, Groundwater, Iron, Hydrogen sulfide, Australia, Perth, Mirrabooka.

A novel process which utilizes fine magnetite particles for the removal of color and turbidity from water has been tested in a 60 l/min pilot plant located at the Mirrabooka Groundwater Treatment Plant in Perth, Western Australia. The feed water is a highly colored anaerobic groundwater which contains significant levels of soluble iron and H2S. The performance of the pilot plant closely matched jar test results. The process design was optimized to achieve a high quality product water on a raw feed which was difficult to treat in the conventional alum coagulation and filtration plant. The successful operation of the pilot plant for the treatment of the Mirrabooka water proved the viability of the magnitite process as an alternative water treatment technique. The Mirrabooka water is a particularly difficult one to treat. A simpler process design would be adopted for other waters which are easier to treat. (Moore-IVI)
W84-02177

REMOVAL AND INACTIVATION OF VIRUSES BY TREATMENT PROCESSES FOR POTABLE WATER AND WASTEWATER-A REVIEW,
Montgomery (James M.), Inc., Pasadena, CA.
For primary bibliographic entry see Field 5D.
W84-02262

EFFECTS OF SUSPENDED SOLIDS ON INACTIVATION OF POLIOVIRUS BY CHLORINE,
Institute of Public Health, Tokyo (Japan). Dept. of Sanitary Engineering.
M. Kaneko, and H. Igarashi.
Water Science and Technology, Vol. 15, No. 5, p 137-143, 1983. 5 Fig, 3 Tab, 10 Ref.

Descriptors: *Virus inactivation, *Chlorination, *Disinfection, *Suspended solids, *Poliovirus, Turbidity, Activated sludge, Kaolin, Water treatment, Residual chlorine.

Solids associated viruses, which were prepared by centrifugation after mixing polioviruses with sterilized kaolin or activated sludge and/or by elution with pH 8, 2% beef extract, were inactivated by chlorine. The activated sludge was found to absorb 96% of total poliovirus added, whereas 74% of the viruses added was adsorbed to the kaolin. Activated sludge which is porous in structure protects the viruses from inactivation by chlorine more effectively than kaolin does. When the concentration of the virus containing solids was 10 mg/l, initial residual chlorine of 1.0 mg/l was not enough to get more than 3 log 10 viral reduction with 30 minutes contact time. The concentration of 1.0 mg/l could affect inactivation of viruses seriously. In order to ensure the effective inactivation of viruses in water, free chlorine residuals of more than 0.4-0.5 mg/l should be maintained for a contact time of at least 30 min at a turbidity of 1-2 units and pH below 8. (Moore-IVI)
W84-02265

VIROLOGICAL STUDY OF DRINKING AND WASTEWATER DISINFECTION BY OZONATION,

Laboatoire d'Hygiene et de Recherche en Sante Publique, Vandoeuvre les Nancy (France). Faculte de Medecine.
Ph. Hartemann, J. C. Block, J. C. Joret, J. M. Foliguet, and Y. Richard.
Water Science and Technology, Vol. 15, No. 5, p 145-154, 1983. 5 Fig, 2 Tab, 24 Ref.

Descriptors: *Ozonation, *Disinfection, *Viruses, *Water treatment, *Wastewater treatment, Poliovirus, Bacteria, Drinking water, Pilot plants.

During laboratory assays of microbiological inactivation in a pilot water treatment plant (36 l/h) with drinking water artifically contaminated with poliovirus 1 and fecal indicator bacteria, ozonation shows a very strong disinfection power. In drinking water, microorganisms are very rapidly inactivated because they are not protected by organic or mineral matter. There is no significant difference in the sensitivity of these microorganisms to ozone. In the same laboratory plant during raw wastewater disinfection assays, the indigenous enteric viruses present a greater resistance to ozone than the indigenous fecal indicators. The application of ozonation for wastewater disinfection is completely different because it is possible to inactivate a large portion of the viruses and bacteria before the 'break point'. There are important difference between the use of laboratory strains and indigenous microorganisms. The findings confirm the interest in ozone disinfection of wastewater at a time of controversy over the need for, and impact of disinfection. (Moore-IVI)
W84-02266

OFF-FLAVOURS IN AQUATIC ECOSYSTEMS - AN INTRODUCTION,
Helsinki Univ. (Finland). Dept. of Limnology.
P. E. Persson.
Water Science and Technology, Vol. 15, No. 6-7, p 1-11, 1983. 2 Tab, 63 Ref.

Descriptors: *Taste, *Odors, *Ecosystems, Natural waters, Drinking water, Fish management, Organoleptic properties, Taste-producing algae, Pollutant identification.

The practical consequences of off-flavors are obvious, and include consumer dissatisfaction, high treatment costs for water works, economic losses to fisheries, and reduced esthetic value of recreational areas. In order to elucidate the sources and causes of off-flavors in natural waters, an integration of sensory, chemical and biological research is needed. Sensory characterization of off-flavors often involves taste and odor threshold measurements. In current water works practice, the odor of water samples is usually characterized by the threshold odor number (TON) test. Instead of using the the geometrical mean of the TONs of the individual panelists, the actual percentage of panelists detecting an odor in each dilution could be determined, and the ensuing graph used to determine the dilution corresponding to 50% detection. There is a need for a more comprehensive approach, where sensory response is related to stimulus intensity over a large range of magnitudes. The use of consumer panels in sensory assessment of water quality is advocated. Sensory methods are useful screening methods. Chemical analyses should be related to the sensory characteristics of the compounds analysed. Recent research on biogenic off-flavors in natural waters have indicated that they are more complex than originally conceived. The following criteria should be used for establishing odor production by organisms: ecological evidence, the concurrence of odor and organism in the field; isolation of organism and proof of odor production in the laboratory; and chemical identification and sensory characterization of odor compounds. Compilations of scientifically proved taste and odor producing algae and microorganisms may be useful, but more research is needed on the reasons for variability of their odor production. The development of relevant abatement techniques depends on a more complete understanding of the etiology of off-flavors in natural waters. (Moore-IVI)
W84-02267

DRINKING WATER CONTAMINATION AND TASTE ASSESSMENT BY LARGE CONSUMER PANELS,
National Inst. for Water Supply, Leidschendam (Netherlands).
E. de Greef, B. C. J. Zoeteman, H. J. van Oers, E. P. Koster, and J. J. Rook.
Water Science and Technology, Vol. 15, No. 6-7, p 13-24, 1983. 5 Fig, 47 Ref.

Descriptors: *Taste, *Drinking water, *Consumer panels, Water pollution, Water quality, Organoleptic properties, Odors, Monitoring.

Sensory evaluation of drinking water is important because it is the ultimate measure of water quality for the consumer, and therefore can be considered as an acceptance criteria. In general the assessment of taste and odor of drinking water is practiced in waterworks laboratories by small panels, but it is not clear if observations by these panels reflect the opinion of the consuming population. Water taste especially is a sensitive parameter, which can be related to the presence of certain toxic chemicals. In an experimental period of 51 consecutive weeks, the sensory water quality of two distribution areas was assessed simultaneously by two consumer panels of about 100 persons each. Large panels can be kept motivated over prolonged periods of time. Comparison of the results of assessments by small laboratory panels with the consumer panel indicate that the latter is far more accurate, inexpensive and reliable and therefore renders a means for monitoring drinking water taste. Application of consumer taste panels will provide the supplier of drinking water with an expedient to establish and maintain acceptance criteria for drinking water quality with respect to taste. A combination of laboratory panels to relate taste and odor of drinking water with treatment methods and consumer panels for public acceptance evaluation is proposed. (Moore-IVI)
W84-02268

ODOUR PROBLEMS IN TWO RESERVOIRS,
Water Research Inst., Prague (Czechoslovakia).
P. Popovska.
Water Science and Technology, Vol. 15, No. 6-7, p 25-33, 1983. 3 Fig, 2 Tab, 24 Ref.

Descriptors: *Odors, *Drinking water, *Dissolved oxygen, Hubenov Reservoir, Klincava Reservoir, Czechoslovakia, Water depth, Actinomycetes, Fungi, Autotrophs, Hydrogen ion concentration.

Water from Hubenov and Klicava reservoirs (Czechoslovakia) is treated for drinking purposes, and off-flavors occur intermittently as indicated by complaints from the public. Klicava reservoir was regularly monitored for almost two years. The dissolved oxygen (DO), pH, water temperature, depth, and the relationship between numbers of autotrophs, Actinomycetes and fungi and odor intensity (OI) were measured. Using statistical methods, the relationships between odor intensity and pH, OI and DO content were shown. By multiple regression, OI in the Klicava water was found to be dependent on the concentration of DO and, to a lesser degree, on water depth. The effect of pH on OI is negligible. The Hubenov reservoir was studied for one year, with special attention to the number of Actinomycetes in particular. A negative correlation between OI and DO in the surface water was found. No significant relationship between numbers of Actinomycetes and odor intensity of the water was found. (Moore-IVI)
W84-02269

STATISTICAL EVALUATION OF THE BLIND TEST METHOD FOR WATER QUALITY CONTROL,
Service de Controle des Eaux de la Ville de Paris (France).
G. Bousquet, J. Ouvrard, S. Rigal, and R. Vilagines.
Water Science and Technology, Vol. 15, No. 6-7, p 35-46, 1983. 5 Fig, 7 Tab, 10 Ref.

Descriptors: *Taste, *Water quality control, *Taste panels, Drinking water, Statistical analysis, Sensory testing.

Each of the three taste panels, consisting of ten persons, participated in 18 water-tasting sessions which included a duplicate estimation of 4 randomly distributed dilutions. The statistical analysis of the 1,440 scores obtained showed a good correlation (r = 0.87) in between scores of the first water tasting and the scores of the second one. Factorial analysis showed that the panelists as a whole find a flavor in the same samples and are able to arrange the dilutions in a proper sequence. This analysis also showed that the differences in the estimation of the intensity of flavor carried out in the absence of periodical calibrations lead to a significant interval between taste threshold values given by each panel. The study of score-dilution contingency tables displayed the sensitivity of each panelist as well as the homogeneity or the heterogeneity of his panel. A change in the water origin and a simple change of the taste panel room reduced temporarily the coherence of scores. The data showed that water tasting is a reliable and reproducible technique in which the observed discrepancies among taste panels are similar to differences found in chemical analyses of palatable substances among laboratories. (Author's abstract)
W84-02270

CASE STUDIES ON OFF-FLAVOURS IN SOME NORWEGIAN LAKES,
Norsk Inst. for Vannforskning, Oslo.
L. Berglind, H. Holtan, and O. M. Skulberg.
Water Science and Technology, Vol. 15, No. 6-7, p 199-209, 1983. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Taste, *Drinking water, *Algae, *Norway, Lakes, Water pollution effects, Cyanophyta, Eutrophication, Oscillatoria, Fish, Decomposition.

During the last twenty years, studies on freshwater algae in Norway have documented recent alterations in the trophic nature of several inland waters. Blooms and changes in type of algae were observed. Mass development of algae, e.g., cyanophytes, upset normal lake metabolism. Objectionable effects on taste and odor in water supplies were reported. Comprehensive studies on off-flavors were done in Lake Mjosa, River Glama, Lake Arungen, Lake Vansjo, and Lake Lyseren. Blooms of Oscillatoria species were associated with the problems in all of the lakes except Lake Lyseren, where primitive waterworks operations allow algae from the lake to enter the water supply system. The algae are decomposed by microbiological activity, forming compounds with objectionalble odors. A muddy or earthy taste and odor can be imparted to water and flesh of fish by substances related to metabolism of cyanophytes and their decomposition products. In most cases when obnoxious tastes and odors occur in drinking water, algae present in the raw water are recognized either as the primary or indirect source. High algal productivity is generally to be expected before problems become severe. (Moore-IVI)
W84-02277

ODOROUS COMPOUNDS OF DIFFERENT STRAINS OF ANABAENA AND NOSTOC (CYANOBACTERIA),
Institut fur Chemische Pflanzenphysiologie der Universitat, Tubingen (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W84-02278

MUNICIPAL DRINKING WATER TREATMENT PROCEDURES FOR TASTE AND ODOUR ABATEMENT - A REVIEW,
Service de Controle des Eaux de la Ville de Paris, France.
A. J. Montiel.
Water Science and Technology, Vol. 15, No. 6-7, p 279-289, 1983. 2 Fig, 8 Tab, 33 Ref.

Descriptors: *Water treatment, *Odor, *Taste, *Paris, *France, Taste panels, Water distribution, Chlorination, Chemical treatment, Organoleptic properties, Drinking water, Water pollution sources, Microorganisms.

Taste and odor of water are sensory qualities the consumers can appreciate very easily. It is of prime importance that, during the water treatment process, taste and odors be removed and that the tap water have no abnormal taste or odor. The water works of Paris (France) has taste panels for checking the water quality by evaluation of taste and odor of water from each treatment stage every two hours. In combination with other analytical techniques, sensory methods permit the detection and localization of sources of pollution, the selection of a water treatment process and the selection of material in contact with drinking water. All the odorous compounds originating in the raw water should be removed in the treatment processes, which are clarification, oxidation and adsorption. There are two options for producing high quality treated water from odorous water: decomposition, or removal of the odorous compounds. In Paris, odorous compounds are removed by slow-sand filtration in Ivry Water Plant, chemical treatment at the Orly Water Works, and chemical and biological treatment at Saint-Maur Pilot Plant. During water treatment processes such as the oxidation stage (chlorination), tastes and odors may be produced and the use of such treatments must be carefully monitored. Tastes may be produced in the water distribution system by microbiological activity, which must be suppressed. (Moore-IVI)
W84-02282

TREATMENT METHODS FOR THE REMOVAL OF OFF-FLAVOURS FROM HEAVILY POLLUTED RIVER WATER IN THE NETHERLANDS - A REVIEW,
National Inst. for Water Supply, Leidschendam (Netherlands).
J. Hrubec, and H. A. M. de Kruijf.
Water Science and Technology, Vol. 15, No. 6-7, p 301-310, 1983. 7 Fig, 25 Ref.

Descriptors: *Water treatment, *Taste, *Odor, *Netherlands, *River Rhine, Water pollution effects, Storage reservoirs, Sand filtration, Ozonation, Activated carbon, Artificial recharge, Dunes.

In The Netherlands the raw water, obtained from the heavily polluted river Rhine, has off-flavors which must be removed by using sophisticated and expensive treatment methods to be acceptable for drinking. One method consists of storage of river water in open bankside reservoirs with residence time of a few months followed by physical-chemical treatment involving coagulation, ozonation, rapid sand filtration, activated carbon filtration and disinfection. Another method used consists of pretreatment of river water by means of coagulation and rapid sand filtration followed by underground storage in the dune areas along the North Sea coast by means of artificial recharge. The water after the recharge is treated by using aeration, dosing of powdered activated carbon, rapid sand filtration and slow sand filtration. The most effective treatment processes for improvement of taste and odor are ozonation and activated carbon filtration. (Author's abstract)
W84-02283

ODOR PROBLEMS IN LAKE BIWA,
Okayama Univ., Kurashiki (Japan). Inst. for Agricultural and Biological Sciences.
M. Yagi, M. Kajino, U. Matsuo, K. Ashitani, and T. Kita.
Water Science and Technology, Vol. 15, No. 6-7, p 311-321, 1983. 8 Fig, 8 Tab, 12 Ref.

Descriptors: *Odor, *Cyanophyta, *Actinomycetes, *Lake Biwa, *Japan, Water treatment, Phormidium, Anabaena, Geosmin, Methylisoborneol, Water analysis, Filtration, Activated carbon.

In 1969 a musty odor was first found in the southern basin of Lake Biwa, Japan. There are three groups of musty odor producing organisms in Lake Biwa: blue-green algae, Phormidium tenue and Anabaena macrospora; attached algae, mainly blue-green algae; and Actinomycetes in the bottom mud. In the 1970's musty odor problems commonly occurred from May to early June due to the metabolites produced by Phormidium tenue. The odor problem in the summer of 1981 was caused by an algal bloom of Anabaena macrospora. Analyses of the water taken in the lake and laboratory cultures of the blue-green algae indicate that 2-methylisoborneol is produced by P. tenue, whereas geosmin is produced by Anabaena macrospora. Purge and trap concentration followed by mass fragmentography was developed and applied as a measurement method for these two odorous compounds. The method was found to be rapid, reproducible and sensitive enough to detect the compounds at a nanogram per liter concentration level or beneath their threshold odors, requiring only a small sample (100 ml). Slow sand filtration was found to be effective in removing odor, where the odorous compounds were reduced to less than 10 ng/l in the effluents. A granular activated carbon filter, which had been in use more than one year and which no longer had the ability to adsorb trihalomethanes, was still effective in removing geosmin and 2-methylisoborneol. (Moore-IVI)
W84-02284

CLEANING AND LINING OLD WATER MAINS SAVES MILLIONS FOR MASSACHUSETTS COMMUNITY,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 8A.
W84-02352

OZONATION FOR EFFECTION THM CONTROL,
City Management Dept., Belle Glade, FL.
R. Wagner, and R. A. Elefritz.
Public Works, Vol. 114, No. 4, p 46-49, April, 1983. 2 Fig.

Descriptors: *Water treatment, *Ozonation, *Trihalomethanes, Drinking water, Ozone, Disinfection, Flocculation, Lake Okeechobee, Belle Glade, Florida.

Belle Glade, Florida is an agricultural community located on the southeast shore of Lake Okeechobee with a population of 17,000. The lake constitutes the only secure supply of fresh water in the Glades region, and the city has used it as a potable supply for many years. Treatment is necessary as the inshore waters are of a poor quality with a great deal of humic color and organic content, turbidity and biological growth. Drought, low lake levels, and periodic irrigation canal back pumping have all compounded the problem. A new process has been developed for Belle Glade involving the use of small amounts of ozone in pre- and post-treatment to modify the trihalomethane precursors in solution. The plan takes advantage of the microflocculation properties of ozone. Small amounts of ozone reacting with organic molecules into much less soluble components. The resulting materials are only semi-soluble and form a foamy particulate mass than can be physically removed from the water flow. The economics of the treatment system are briefly considered. (Baker-IVI)
W84-02353

WHEN OPEN TAPS ONLY DRIP,
Wade, Trim and Associates, Inc. Taylor, MI.
D. R. Trim.
Public Works, Vol. 114, No. 6, p 60-62, June, 1983. 2 Fig.

Descriptors: *System analysis, *Water management, Kalamazoo, Portage, Michigan, Water supply development, Pumps, Reservoirs, Hydraulic equipment, Planning.

About 300,000 customers currently draw water from 117 wells that supply five distribution zones for the city of Kalamazoo plus inhabitants of the city of Portage and five suburban townships. The distribution zones make up a total network of about 500 miles of 2 inch through 30 inch diameter mains, involving 20 pumping stations with chlorination facilities, and augmented by 16 million gallons of above ground storage capacity. During the winter about 18 million gallons per day are consumed. In the summer the use rises to 30 to 35 million gallons. A hydraulic network analysis was completed to deal with problems of low pressure in the system. The analysis called for construction of a reservoir of the Hydropillar design type. An extensive review of various types of pumps to be used in a new pumping station was made, also resulting from the network analysis. Currently the reservoir in combination with the pumping station and well fields will supply drinking water in the study zone for the next 20 to 30 years, all the while maintaining adequate pressure. (Baker-IVI)
W84-02358

CORROSION AND SCALE INHIBITORS FOR WATER DISTRIBUTION SYSTEMS,
Stearns and Wheeler, Cazenovia, NY.
W. E. McFarland.
Public Works, Vol. 117, No. 7, p 53-56, July, 1983. 1 Tab.

Descriptors: *Corrosion control, *Chemical treatment, *Water distribution, Corrosion, Scaling, Fouling, Water conveyance, Potable water, Public health, Water treatment, Corrosion control.

Corrosion and scaling are continuous problems in many water systems and may go unnoticed in day to day operations. Fire flow tests and Hazen-Williams C value determinations are useful indicators for assessing the condition of a distribution system and the need for a scale or corrosion control program. Operating costs increase as a distribution system deteriorates. Effects of corrosion and scaling on plumbing systems and hot water heaters also result in increased costs to users, although they are not reflected in the waterworks budget. With proper water treatment, many of the problems of corrosion and scaling can be reduced. A conventional method of treatment is to adjust pH, calcium, and alkalinity levels to where the water is balanced relative to calcium carbonate. An alternative method of corrosion control is the use of inorganic chemical inhibitors. In addition to applications in distribution systems, chemical inhibitors have been found useful for redeveloping water wells, and can help prevent formation of deposits on filters and other equipment in water treatment plants. Most chemical inhibitor products are readily dissolved in water and are designed for addition as a dilute solution. Even so, they should be added only after careful experimentation and with complete approval of state and local health agencies, when they are to be used in potable waters. (Baker-IVI)
W84-02361

ACTIVATED CARBON TREATMENT RESTORES ACTON WATER SUPPLY,
Acton Water District, MA.
J. E. MacLeod, and G. A. Allan.
American City and Country, p 32-35, November, 1983.

Descriptors: *Drinking water, *Activated carbon, Adsorbents, Acton, Massachusetts, Aquifer management, Groundwater pollution, Water quality, Aeration, Hydrocarbons, Chlorinated hydrocarbons.

During the past four years the closing of more than two dozen public water supplies in Massachusetts has demonstrated the susceptibility of groundwater to contamination. One of the first communities to be affected was Acton, located 22 miles west of Boston. Two wells were removed from service due to contamination with several organic chemicals, including trichloroethylene, dichloroethylene, methylene chloride and benzene. The probable cause of contamination was the waste disposal practices of a nearby chemical plant. The primary source were a landfill and several lagoons filled with liquid wastes, located about 2,500-3000 ft north of the municipal wells. The groundwater gradient across the aquifer slopes from north to south. Rather than seek new supplies, Acton decided to treat the volatile organics and proved such a step to be only possible but economical as well. Granular activated carbon and aeration were effective in removing the chlorinated hydrocarbons from the aquifer. (Baker-IVI)
W84-02372

5G. Water Quality Control

MOVEMENT OF BACTERIA AND NUTRIENTS FROM PIT LATRINES IN THE BOUNDARY WATERS CANOE AREA WILDERNESS,
North Central Forest Experiment Station, Grand Rapids, MN. Forestry Sciences Lab.
D. S. Nichols, D. Prettyman, and M. Gross.
Water, Air, and Soil Pollution, Vol. 20, No. 2, p 171-180, August 1983. 4 Tab, 33 Ref.

Descriptors: *Latrines, *Water pollution control, *Bacteria, *Nutrients, Camp sites, Boundary Waters Canoe Area, Minnesota, Water quality, Nitrogen, Phosphorus, Fecal bacteria, Peat liners.

Sanitary facilities in the Boundary Waters Canoe Area Wilderness (BWCAW) in the Superior National forest in northeastern Minnesota consist of about 2100 pit latrines located at campsites on about 400 lakes. Because of the heavy visitor use and the thin mantle of soil over bedrock in many places, there is concern that the high-quality surface waters may be polluted by microorganisms and nutrients from the pit latrines. The movement of fecal bacteria, N, and P from pit latrines in the BWCAW was studied, as well as the effectiveness of peat latrines in reducing this movement. When latrines are constructed where only a thin layer of permeable soil overlies bedrock or other impermeable material, fecal bacteria can be carried considerable distances by subsurface flow. Lining latrine pits with acid peat appears to reduce bacteria transport. Most soils strongly adsorb P and prevent its movement. No movement of P from latrine pits was seen except at one site with very sandy soil. In such soil a peat liner appears to be of some value, if a peat with a high P adsorption capacity is used. A peat liner should be viewed as an additional protection against P and bacteria movement rather than as a substitute for proper soil conditions. Latrines should not be built in thin, rocky soils. Nitrogen appears to move readily from toilet pits, regardless of soil type or presence of peat liners. But, because of dilution, N is not likely to have a discernible impact on water quality. (Moore-IVI)
W84-02136

EVALUATION OF SEDIMENT AND PHOSPHORUS MANAGEMENT PRACTICES IN THE WHITE CLAY LAKE WATERSHED,
Wisconsin Dept. of Natural Resources, Madison.
L. A. Persson, J. O. Peterson, and F. W. Madison.
Water Resources Bulletin, Vol. 19, No. 5, p 753-762, October, 1983. 2 Fig, 9 Tab, 21 Ref. EPA grant R804823.

Descriptors: *Water quality management, *Sediments, *Phosphorus, Nonpoint pollution sources, White Clay Lake, Wisconsin, Mathematical models, Animal wastes, Land use, Nutrients, Water pollution control, Soil erosion, Snowmelt, Thaw, Farm wastes, Phosphorus, Lakes, Wetlands, Agricultural runoff.

To evaluate the effects of management practices for protection of water quality in White Clay Lake (Wisconsin), surface and lake waters were monitored for a six-year period before and during structural and management changes for nonpoint pollution source control. The incremental nature of implementing controls combined with the annual variations in sediment and nutrient transport confounded obvious changes in water quality. So, several models were linked together to define loadings from specific land uses and to assess the effects of management changes and animal waste control measures designed to reduce sediment and phosphorus losses. The importance of including the thaw and snowmelt factor in the determination of erosion index for the Universal Soil Loss Equation was demonstrated. Model predictions of average annual phosphorus loading showed a 54% reduction following the installation of manure storage facilities and barnyard runoff controls, and a 22% reduction through changes in cropland management. The model also predicted a 29% reduction in sediment loading. The value of a peripheral wetland for retention of sediment and phosphorus was quantified. Changes in lake water quality attributable to the watershed work were not observed, but maintenance of existing good water quality as a result of this project is anticipated. (Author's abstract)
W84-02163

EFFECTS OF HYDRILLA AND GRASS CARP ON WATER QUALITY IN A FLORIDA LAKE,
Florida Univ., Gainesville. Center for Aquatic Weeds.
D. E. Canfield, Jr., M. J. Maceina, and J. V. Shireman.
Water Resources Bulletin, Vol. 19, No. 5, p 773-778, October, 1983. 2 Fig, 1 Tab, 38 Ref.

Descriptors: *Hydrilla, *Aquatic plants, *Aquatic weed control, *Grass carp, Environmental effects, Chlorophyll a, Transparency, Alkalinity, Calcium, Magnesium, Potassium, Phosphorus, Lake Baldwin, Florida.

Changes in water chemistry, water clarity, and planktonic chlorophyll a were measured as hydrilla (Hydrilla verticillata) abundance increased and then decreased in Lake Baldwin, Florida. Grass carp (Ctenopharyngodon idella) were used to eliminate submersed macrophytes. No major trends in lake pH, conductivity, or total nitrogen concentrations occurred in association with changes in hydrilla levels. Increased Secchi disc transparency and reductions in total alkalinity, calcium, magnesium, potassium, total phosphorus, and chlorophyll a concentrations occurred as hydrilla abundance increased. Large increases in the chemical parameters and a reduction in Secchi disc transparency occurred as hydrilla decreased and was eliminated from the lake by grass carp. The effects of hydrilla on lake water chemistry are related to the percentage of the lake's volume infested with hydrilla and macrophyte standing crop. (Author's abstract)
W84-02166

CONTROLLING GROUND WATER DEGRADATION IN THE TULARE LAKE BASIN,
California Univ., Davis. Dept. of Civil Engineering.
O. Helweg, and S. Arora.
Water Resources Bulletin, Vol. 19, No. 5, p 837-844, October, 1983. 5 Fig, 5 Tab, 8 Ref. OWRT project A-529-CAL, WRC project UCAL-WRC-W529.

Descriptors: *Groundwater pollution, *Salinity, *Water quality control, Tulare Lake Basin, California, ASTRAN, Irrigation effects, Water pollution control, Fertilizers, Soil amendments, Computer models.

The feasibility of extending the Accelerated Salt Transport (ASTRAN) method of ground water quality control to a complex, closed basin which is experiencing ground water quality degradation from irrigated agriculture (e.g. the Tulare Lake Basin in the southern portion of the California Central Valley) was examined. A linear programming model was constructed and parametric analysis conducted which produced results with a 'general appraisal' (or 'level B') degree of accuracy. The groundwater salinity will continue to increase unless substantial measures are taken to control the trend. The ASTRAN method along with the other controls such as limiting new land development and increasing the application efficiency of fertilizers and soil amendments can control groundwater salinity (degradation). Applying the ASTRAN method will not have as great an impact as preventing future leaching of salts from native subsoils and limiting salinity from soil amendments. There is no apparent feasible way salinity can be controlled as formulated in this study without additional imported water and additional drainage out of the basin. (Moore-IVI)
W84-02174

EARLY WARNING SYSTEM FOR DETECTING EARTHY-MUSTY ODORS IN RESERVOIRS,
Metropolitan Water District of Southern California, La Verne. Water Quality Branch.
M. J. McGuire, S. W. Krasner, C. J. Hwang, and G. Izaguirre.
Water Science and Technology, Vol. 15, No. 6-7, p 267-277, 1983. 8 Fig, 1 Tab, 6 Ref.

Descriptors: *Odors, *Monitoring, *Reservoirs, *Oscillatoria, *Lake Mathews, California, Methylisoborneol, Closed-loop stripping analysis, Cyanophyta, Sampling, Algicides, Diffusion, Thermoclines, Water quality control.

A taste and odor problem in 1980 in Lake Mathews, a reservoir in Southern California, was detected after it was already well under way. An early warning system was devised in 1981 to detect an earthy-musty odor problem in its formative stage. Oscillatoria curviceps was confirmed as the organism which caused nuisance levels of 2-methylisoborneol (MIB) in Lake Mathews. The early warning system was specifically developed to monitor attached blue-green algal growths in a reservoir using closed-loop stripping analysis (CLSA) of samples collected near the growths. The CLSA technique proved to be a reliable and rapid methos of determining ng/l concentrations of an earthy-musty organic compound. Sampling above the attached blue-green algal growths and analysis by CLSA gave one month's warning of an odor problem in Lake Mathews. Fixed monitoring stations and a similar sampling and analysis scheme can be used by other utilities to solve similar problems. MIB appeared to diffuse through a strong thermocline and became thoroughly mixed in the water column. Application of Cutrine-Plus as an algicide for bottom-growing organisms had a limited effect in this instance. Death of O. curviceps appeared to be from natural causes. (Moore-IVI)
W84-02281

MEASURES TO PREVENT WATER POLLUTION BY CHEMICAL FERTILIZERS AND SOIL EROSION PRODUCTS,
For primary bibliographic entry see Field 5B.
W84-02324

PROTECTION OF SURFACE WATERS IN THE USSR,
V. S. Kaminskii.
Water Resources, Vol. 9, No. 6, p 635-649, November-December, 1982. 66 Ref. Translated from Vodnye Resursy, No. 6, p 93-109, November-December, 1982.

Descriptors: *Surface waters, *Water quality control, *USSR, Environmental protection, Water pollution control, Political aspects, Industrial wastes, Legislation, Acid rain, Water analysis.

Control of environmental pollution to protect the quality of available water is becoming an increasingly important problem and concern in the world. The manner in which the problem is addressed in socialistic countries is compared briefly with the approach in capitalistic societies. The impact of Lenin's theory and practice of environmental protection is noted. Soviet legislation in this area is mentioned. Since 1972 more than 400 water protection installations with a total capacity of about 1.5 cu km/year and also biological wastewater treatment plants of about the same capacity have been put into operation at more than 300 enterprises of the basin in Kalinin, Gorky, Kuibyshev, Ul'yanovsk, Volgograd, and other cities. In the main harmful substances still enter the waterways from the fuel and power industry, metallurgical, chemical, petrochemical, pulp and paper, light and food industries and also through agricultural production. Evaluation of water quality from hydrobiological positions has been investigated with a multitude of biotests being proposed in the world literature for that purpose. A comparative evaluation of different systems of hydrobiological analysis of polluted waters in rivers was made. The Woodiwiss method proved the most suited for biological analysis. Problems being experienced through the precipitation of acid rains are noted. In the 11th Five Year Plan there will be a united collaboration of fraternal union republics which will be a decisive step forward in improving the quality of one of the most important components of the biosphere, fresh water. (Baker-IVI)
W84-02338

IS YOUR COMMUNITY'S GROUNDWATER SAFE TO DRINK,
Malcolm Pirnie, Inc., Paramus, NJ.
A. F. Hess, J. E. Dyksen, and H. J. Dunn.
Public Works, Vol. 114, No. 10, p 72-76, October, 1983. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Groundwater protection, *Monitoring, Chlorinated hydrocarbons, Solvents, Organic compounds, Inorganic compounds, Fluoride, Nitrates, Barium, Selenium, Arsenic.

A number of groundwater supplies around the United States have experienced water quality degradation due to high inorganic and/or organic chemical levels. Finding cost-effective means of controlling these chemicals represents a challenge for water suppliers and water utility engineers. However, proper planning and evaluation of alternatives will enable water utilities to provide an effective method for ridding groundwater supplies of many inorganic and/or organic problems. The five most abundant primary inorganic contaminants are fluoride, nitrate, selenium, barium, and arsenic. Groundwater supplies with organic contaminants typically contain several solvents. Of all the groundwater samples collected and analyzed, trichloroethylene has been detected more frequently and in the highest concentrations. Tetrachloroethylene ranks second in frequently of occurrence. Within a specific well, at least one or two organic compounds at relatively high concentrations of 100-500 micrograms/liter will likely predominate with several other identifiable compounds present at lower concentrations or less than 50 micrograms/liter. A given wellfield may include one well with a preponderance of one or two compounds at high concentrations, whereas in another well in the same area several different compounds may dominate. (Baker-IVI)
W84-02362

INTRODUCTION TO THE NIAGARA RIVER/LAKE ONTARIO POLLUTION PROBLEM,
Canada Center for Inland Waters, Burlington, Ontario. National Water Research Inst.
R. J. Allan, A. Mudroch, and A. Sudar.
Journal of Great Lakes Research, Vol. 9, No. 2, p 111-117, 1983. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution control, *Governmental interrelations, *Lake Ontario, *Niagara River, Great Lakes, Water pollution sources, Toxic substances, Hazardous wastes, Waste disposal, Monitoring, Canada, United States.

A cooperative effort has been begun by Canadian and United States research scientists to provide basic information which may be needed to enforce controls of loadings of toxic chemicals to the Lake Ontario and Niagara River system. The objectives of the cooperative effort will be to define the past and present status of contamination and develop a predictive capacity in relation to control alternatives; to provide information that will lead an assessment of the need to reconstruct old or redesign new waste dumps; provide information to support bilateral negotiations aimed at control of point and diffuse sources of hazardous chemicals; provide information that will assist in the design of scientifically sound monitoring strategies to assess reductions in point and non-point sources of toxic chemicals to Lake Ontario, and provide, if feasible, input to whole lake or basin management strategies which may accelerate recovery of Lake Ontario. (Baker-IVI)
W84-02402

SPONTANEOUS POTENTIAL CORRECTIONS FOR GROUNDWATER SALINITY CALCULATIONS - CARTER COUNTY, OKLAHOMA, U.S.A.,
Bradley Univ., Pretoria, IL. Dept. of Geological Sciences.
C. L. McConnell.
Journal of Hydrology, Vol. 65, No. 4, p 363-372, September, 1983. 7 Fig, 14 Ref.

Descriptors: *Groundwater, *Salinity, Water quality control, *Carter County, *Oklahoma, Water pollution prevention, Oil wells, Oil industry, Dissolved solids,.

The thickness and distribution of groundwater with a total dissolved solids (TDS) of less than 1000 mg/l were computed using the spontaneous potential log for Carter County, Oklahoma. Empirical correction factors had to be developed and applied to compute accurate salinities from the spontaneous potential in high-resistivity zones. Present equivalent water resistivity vs water resistivity curves were developed for the formations from chemical analyses and digitized. Water resistivity vs TDS curves were also developed and digitized. The existing empirical thin-bed corrections were curve-fit with equations and applied to each zone. Except in beds less than 3.65 m thick they had little effect. A data base was compiled using 704 oil-well electric logs including data from all zones from the base of the regolith to a depth where the TDS was greater than 10,000 mg/l TDS. The TDS was computed for each zone. Two maps were prepared from the results; an isopach of the formations with TDS of less than 1000 mg/l and a depth to the base of the water with TDS of 1000 mg/l. The borehole environmental correction factor was greater for salty muds than predicted by earlier electric analog models. This correction was largely independent of bed thickness between 3.65 and 7.60 m which is the normal thickness of these beds. Testing the correction factors on zones of known water chemistry zones have TDS of about 750 mg/l lowered the average computed TDS from 1030 to 823 mg/l. (Baker-IVI)
W84-02456

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

WATER SUPPLY AND URBAN GROWTH PLANNING: A PARTNERSHIP,
Palliser Regional Planning Commission, Hanna (Alberta).
W. J. Ashton, and M. B. Bayer.
Water Resources Bulletin, Vol. 19, No. 5, p 779-783, October, 1983. 3 Fig, 1 Tab, 13 Ref.

Descriptors: *Water supply, *Land use, *Planning, *Urban areas, Water resources development, Water demand, Water conservation, Regional planning, Regional development, Calgary, Alberta.

As urban expansion outstrips water supplies, the usual solution is to build pipelines to bring in water from sources farther afield. Such water supplies may act as either a leader of urban development or as a follower. In either case, this engineering approach to the provision of water has fostered less than optimal utilization of regional water and land resources for urban growth. More efficient utilization of these resources is achieved when water supply development and urban growth planning are conjoint activities. Water supply planners and land use planners, working together, are able to generate and evaluate the full range of urban development options, including water demand management through conservation. Preferred regional growth plans are achieved using the best mix of water supply and urban growth. The result is a reduced rate of water supply development and a reduction of urban expansion on prime lands. This partnership approach is demonstrated for the Calgary Region (Alberta) under two levels of water conservation. (Author's abstract)
W84-02167

PERSPECTIVES ON THE FUTURE OF THE INDIAN RIVER SYSTEM,
Florida Sea Grant Marine Advisory Program, Melbourne.
L. T. Johnson.
Florida Scientist, Vol. 46, No. 3/4, p 132-134, 1983. 4 Ref.

Descriptors: *Water resources development, *Indian River system, *Florida, Planning, Information, Resources development.

The Indian River system extends from Ponce de Leon Inlet to St. Lucie Inlet (Florida) and drains an increasingly populated watershed. The Future of the Indian River system (FIRST) Steering Committee was formed in April 1981 by representatives of 4 Florida scientific institutions to promote the wise utilization and optimum productivity of the Indian River system. This system is a significant economic, scientific, educational, recreational, and aesthetic resource. The FIRST Steering Committee will form a permanent organization to act as a clearing house for information on the Indian River system and to sponsor annual symposia. Symposia will alternate between research needs, and potential solutions will be discussed and referred to decision makers. The Indian River System Information Symposium is the first of the research meetings. (Author's abstract)
W84-02248

HIERARCHICAL MODEL OF OPTIMIZATION OF THE STRUCTURE OF WATER RESOURCES SYSTEMS,
D. Velev, I. Mesechkova, and V. Mikhailov.
Water Resources, Vol. 10, No, 1, p 1-7, January-February, 1983. 1 Fig, 6 Ref. Translated from Vodnye Resursy, No. 1, p 3-10, January-February, 1983.

Descriptors: *Model studies *Decision making, *Water resources development, Water supply, Hierarchical models, Optimization, Planning.

Attempts are made to optimize the decisions as to when, where and what type of water resource systems (WRS's) should be formed and developed to meet the ever increasing water requirements most economically. The specific character of the problem of developing WRS's governs the direct relation between investigations in this area and long range national economic planning. WRS's belong to the class of large dynamic systems whose main charactertistics are a hierarchical character and complex structural interrelations between elements. Optimization of individual subsystems is carried out at the first level of the hierarchy with given values of certain variables determined by the coordinator of the second level. In the next stage the first level reports the values of the objective functions of the subsystems to the coordinator of the second level, who assigns new values of the coordinating variables. This process continues until the global optimum of the systems is determined. For WRS's with limited water resources a correctly selected strategy of development for a long period can lead to more favorable results and is the decisive condition for effective use of water resources. (Baker-IVI)
W84-02340

ANALYSIS OF THE EFFECTIVENESS OF USING INFLOW AND WATER CONSUMPTION FORECASTS WHEN CONTROLLING WATER RESOURCES SYSTEMS,
P. Kvasnikov.
Water Resources, Vol. 10, No. 1, p 15-19, January-February, 1983. 3 Fig, 12 Ref. Translated from Vodnye Resursy, No. 1, p 19-24, January-February, 1983.

Descriptors: *Planning, *Water resources development, Water supply, Bulgaria, Model studies, Water demand, River forecasting, Consumptive use, Irrigation, Floods, Low flow.

The steady increase of water consumption in Bulgaria is necessitating the more rational and effective use of limited water resources. One way of solving the problems is to improve the existing methods of controlling water resources systems by using forecasts of the inflow and water consumption which is especially essential for the irrigation of farmlands. At present consumptive use is forecast on the basis of a forecast of the available heat supply and cumulative soil moisture deficits during the entire growing season. The optimal distribution of water between crops is carried out under conditions of a shortage of water resources, which requires forecasting the loss functions for all crops. The content and form of forecasts of inflow into a reservoir are quite diverse and depend both on the purpose of the forecasts and on the possibilities of

obtaining them. Considerable research has been carried out in Bulgaria in the area of long range forecasting of river runoff for issuing probability forecasts for the spring flood and summer low streamflow periods and attempts have been made to compile basic long range and very long range forecasts of inflow to reservoirs. The use of simulation modeling to solve these problems is considered. (Baker-IVI)
W84-02342

OPTIMIZATION OF THE OPERATING AND REORGANIZATION OF EXISTING COMPLEX WATER RESOURCES SYSTEMS,
S. Yancheva.
Water Resources, Vol. 10, No. 1, p 20-28, January-February, 1983. 6 Fig, 1 Tab, 28 Ref. Translated from Vodnye Resursy, No. 1, p 25-34, January-February, 1983.

Descriptors: *Water resources development, *Planning, Model studies, Mathematical models, Dam construction, Reservoirs, Decision making.

The problem of coordinating the varying resources of water and the demand for water as it concerns providing the economy with water and conserving water resources is addressed. The main means of achieving such control is the redistribution of water resources in time by streamflow regulation by reservoirs, and in space by interbasin and interregion water transfers. The problem of designing water systems in general is presently regarded as a two stage problem of stochastic programming. In the first stage of solution the main parameters of the water system are established and in the second stage the control regime providing fulfillment of the selected parameters is determined. The use of results of optimizing long and short range operating regimes of a water system for determining its parameters is a possible unified methodological basis for solving the indicated problems. The probabilistic component of water consumption is determined by the random factors influencing it. Mathematical models are presented for optimization of the operation and reorganization of developing water systems, for verification of the regulating possibilities of existing complex water resources systems, and for the buildup of the reservoir without water transfer from other sources. (Baker-IVI)
W84-02343

PUTTING MICROCOMPUTERS TO PRACTICAL USE ON WATER AND WASTEWATER PROJECTS,
Camp, Dresser and McKee, Inc., Walnut Creek, CA.
P. Giguere.
Public Works, Vol. 114, No. 5, p 50-52, 90, May, 1983. 2 Fig.

Descriptors: *Computers, *Management, Wastewater treatment, Water management, Groundwater, Groundwater pollution, Water supply, Microcomputers, Systems analysis.

The advent of the powerful, low cost microcomputers and easy to use application programs has made possible the use of computers to assist in computations, data management, report writing, design, budgeting, and project management to a far greater extent than was heretofore possible. Recent applications in the wastewater and water resources fields include groundwater and surface water modeling, sewer system analysis and design, water distribution system analysis, data management, construction quantity take-offs, and cost estimating. Somewhat detailed examples of the usefulness of small computers are offered in the areas of sewer master planning and treatment plant management. Other recent applications of computer systems include water allocation and groundwater pollution. (Baker-IVI)
W84-02355

6B. Evaluation Process

SOCIAL IMPACT OF RESERVOIR CONSTRUCTION IN THE URBAN FRINGE: A TEN-YEAR COMPARISON,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
T. L. Napier, E. G. Bryant, and S. McClaskie.
Water Resources Bulletin, Vol. 19, No. 5, p 811-819, October, 1983. 3 Fig, 47 Ref.

Descriptors: *Social impact, *Reservoirs, *Attitudes, Public opinion, Social adjustment, Social change, Water resources development.

A longitudinal research design was used to compare attitudes toward selected components of a reservoir affected community in the urban fringe of a major metropolitan area in central Ohio. The study data were collected at three intervals over a ten-year period (1970, 1974, 1980). Evaluation of resident opinions in the affected community revealed significant attitude differences over time for four of the five variables measured. The study group desired more social stability but had accommodated the changes experienced to date. Responses to the attitude scales showed that the people in the study group were well integrated and were closely identified with each other at all three test periods. Given the magnitude of changes introduced in the community, the positive findings strongly suggest that the social fabric of human groups is very resilient and is quite adaptive to extensive changes even when the social milieu is subjected to considerable stress. These data also suggest that inmigrants were being quickly assimilated into the restructured social milieu. Attitudes toward the lake project were significantly more positive over time, and in 1980 the collective community group held a basically neutral attitude about the lake. Both long-term and short-term residents are becoming more positive over time concerning the actions of the development agency. (Moore-IVI)
W84-02171

OPPORTUNITY COST OF TRAVEL TIME IN RECREATION DEMAND MODELS,
Vanderbilt Univ., Nashville, TN. Dept. of Economics.
V. K. Smith, W. H. Desvousges, and M. P. McGivney.
Land Economics, Vol. 59, No. 3, p 259-278, August, 1983. 6 Tab, 33 Ref.

Descriptors: *Recreation demand, *Cost analysis, *Model studies, Recreation, Water demand, Water use, Dams, Lakes, Reservoirs, Rivers, Travel time.

Current proposals for valuing travel time in the specification of recreation demand models is evaluated. Based on a household production framework, the analysis examines the implications of the treatment of travel and onsite times in recreation models. The empirical results are based on demand functions estimated for 43 water based recreation sites with the Federal Estate component of the 1977 National Recreation Survey. A redirection in the research on modeling the demand for outdoor recreation sites is warranted. The theoretical analysis implies that the definition of the nature of and the interrelationship between an individual's time constraints plays a central role in the determination of the individual's corresponding opportunity cost of travel time. The empirical findings of forty-three site demand models for water recreation suggest that the treatment of the costs of on-site time is important to the empirical analysis of the oppportunity cost of travel time; that the difference between the full-cost and Cesario proposals for measuring these opportunity costs are not sufficient to prefer the latter to the former; and that the estimation of the multiple relating these opportunity costs to the wage is not a trivial task. (Baker-IVI)
W84-02233

DEMAND CURVE FOR RECREATIONAL FISHING WITH AN APPLICATION TO STOCK ENHANCEMENT ACTIVITIES,
Delaware Univ., Newark. Coll. of Marine Studies.
L. G. Anderson.
Land Economics, Vol. 59, No. 3, p 279-286, August, 1983. 3 Fig, 14 Ref. NSF Grant 75-11205.

Descriptors: *Recreation demand, *Model studies, *Sport fishing, Recreation, Fishing, Fish stocking, Fish ladders.

Models of recreational fishing have been developed by earlier studies and have derived conditions for optimal management policy both with and without joint commercial harvest. While these earlier models are correct, their structures do not explicitly consider the stock externality in terms of the demand curve for recreational fishing. In many recreational fisheries, it is possible to undertake activities, such as fish stocking and construction of fish ladders, which can affect the exploited stock such that the quality of recreational fishing is improved. The effect each participant has on others, in terms of quality and quantity, is central to an intuitive understanding of recreational fisheries management and it can be clearly demonstrated in the demand curve model presented in this study. The model is applicable to a number of relevant problems, including joint recreation-commercial exploitation, but it is applied in this work to the optimization of enhancement. (Baker-IVI)
W84-02234

OPTIMAL CONTROL OF COMPLEX WATER RESOURCES SYSTEMS IN BULGARIA,
N. Kolev, S. Yancheva, and K. Nikolova.
Water Resources, Vol. 10, No. 1, p 8-14, January-February, 1983. 6 Fig, 4 Ref. Translated from Vodnye Resursy, No. 1, p 11-18, January-February, 1983.

Descriptors: *Planning, *Water resources development, *Bulgaria, Mathematical models, Model studies, Reservoir operation, Water demand.

Optimization of the regimes of use and distributions of water resources of a real complex water resources system with a seasonal reservoir is discussed. A four stage mathematical model is proposed for optimal control of the complex water resources system under water shortage conditions. In the first stage the regulating possibilities of the existing reservoir are checked on the basis of optimization calculations, and variants for its reorganization are outlined if necessary. The second stage consists in solving the distribution problem, in which, by optimal distribution of the water shortage between participants of the complex water resources system on the basis of the technicoeconomic characteristic of individual water consumers and users, their requirements are coordinated with the available water resources. In the third stage the distribution of optimal water deliveries between water consumers and users of the system is carried out on the basis of the results obtained on solving the regime problem. (Baker-IVI)
W84-02341

SEWER SYSTEM REHABILITATION BY THE NUMBERS,
Donohue and Associates, Inc., Waukesha, WI.
J. S. Kipp.
Public Works, Vol. 114, No. 5, p 75-76, May, 1983.

Descriptors: *Sewer systems, *Rehabilitation, Design criteria, Planning, Decision making, Engineering.

A typical scenario of the sewer rehabilitation process is presented so that projects can proceed smoothly and produce the repairs needed to provide efficient, effective, and economical sewer service. The overall rehabilitation process is a three-step process. First, the Sewer System Evaluation Survey is made and subsequent rehabilitation recommendations made based on the survey results. Secondly, the engineering design of the repairs themselves is completed. Thirdly, detailed construction inspection is carried out during the actual repair work. This three step process has allowed for cost effective identification, design, and construction of those repairs needed to restore the sewer system under question to a proper level of service. (Baker-IVI)
W84-02357

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER RATES: DO THEY REFLECT COSTS,
Michigan Dept. of Public Health, Escanaba. Environmental and Occupational Health Sciences Administration.
C. L. Courchaine.
Public Works, Vol. 114, No. 6, p 86-88, June, 1983. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Water rates, Economic aspects, Costs, Michigan, Upper Peninsula, Water treatment, Construction.

A water rate study was conducted in 1982 by means of a questionnaire initially sent to 90 water suppliers in the Upper Peninsula of Michigan. An excellent 95.5% response rate was achieved. Water rates appeared to be more affected by the source and type of treatment than by size. The least expensive public water supplies are those where groundwater is available and do not require treatment for either public health or aesthetic reasons, regardless of the size of the community. Purchased water was among the most costly means of obtaining a drinking water source in the study area. This is affected greatly by the interpretation of Michigan's former law that permitted water suppliers to charge outside customers 3200% of its own customer rates. Twenty-three communities have a water rate less than the $6 per month for 5000 gallons, and they have a median water rate of $4. These communities have had an increase in water rates of only 16.5% since 1977. In contrast, the 19 communities with a water rate greater than $10 per month for 5000 gallons have a median water rate of $12.50, and these communities have had an increase in water rates of 84% in the last five years. The predominant difference in these two groups of water supplies is that the latter have had a high percentage of construction projects that affect water rates. New concepts in rate making should be considered to assure that water rates reflect the real cost of providing service on an equitable basis. (Baker-IVI)
W84-02360

SEWAGE GRANT FUNDING IS KEY IN CLEAN WATER ACT CHANGES,
C. H. Dombrowksi.
American City and Country, p 27-28, November, 1983.

Descriptors: *Grants, *Sewer systems, Economic aspects, Clean Water Act, Federal jurisdiction, Pretreatment, Wastewater treatment.

Funding for federal sewage grants is becoming an important issue for local government officials. Amendments to the 1981 Clean Water Act (CWA) have allowed Congress to lower the percentage of sewage costs that the federal government will finance. About 5000 communities will not receive federal grants and will have to develop plans for achieving secondary treatment on their own. The most controversial issue to the local government is pretreatment. The existing program is criticized as being too cumbersome and complicated. Also being debated in this round of the CWA amendments is a new program for control of nonpoint source pollution. Problems with compliance with secondary treatment have also been raised. (Baker-IVI)
W84-02371

6D. Water Demand

CONTROL OF THE LEVEL OF LAKE ISSYK-KUL,
For primary bibliographic entry see Field 4A.
W84-02319

WATER RESOURCES, CURRENT CHARACTERISTICS, AND PROSPECTS OF WATER CONSUMPTION IN THE USA,
L. I. El'piner, and V. S. Vasil'ev.
Water Resources, Vol. 10, No. 1, p 114-121, January-February, 1983. 4 Tab, 10 Ref. Translated from Vodnye Resursy, No. 1, p 163-172, January-February, 1983.

Descriptors: *Water resources development, *Water consumption, Reviews, United States, Conservation, Industrial water, Water reuse, Consumptive use.

The rational use of water resources in the United States is reviewed. Data are provided on the characteristics of US reservoirs; on freshwater consumption in the period 1940-1975 and its forecast for 1985 and 2000; the structure of consumption of subsurface freshwaters by various sectors of the US economy such as agriculture, municipal services, industry and thermal power; the consumption of water resources by various manufacturing industries in 1975 such as chemical, iron and steel, pulp and paper, petroleum, food, transportation equipment, textiles, and other branches of the manufacturing industries. Summing up the results of analyzing the data on the use of water resources in the US it is noted that the decrease of the total volume of water consumption achieved in the mid-1970's is more correctly regarded as stabilization of its level, which is also important. The predicted estimates of the further development of this process indicate the possibility of a temporary decrease of the level of water consumption due to the introduction, mainly in the manufacturing industry, of recycled water supply systems. However, the increase of nonreturnable water consumption accompanying these methods at the level of the year 2000 will subsequently require the replacement of recycled water supply by the introduction of zero-water technological processes. Otherwise the trend toward an increase in water consumption will again intensify and cause acute situation in the United States due to the shortage of water resources. (Baker-IVI)
W84-02348

6E. Water Law and Institutions

PROTECTION OF SURFACE WATERS IN THE USSR,
For primary bibliographic entry see Field 5G.
W84-02338

6G. Ecologic Impact Of Water Development

ICE AND THERMAL CONDITIONS OF THE POOLS AT THE UST'-ILIM HYDROELECTRIC STATION,
Ya. L. Gotlib, M. V. Gorina, and A. I. Khydyakova.
Hydrotechnical Construction, Vol. 17, No. 2, p 85-89, February, 1983. 2 Fig, 5 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, o. 2, p 29-31, February, 1983.

Descriptors: *Hydroelectric plants, *Environmental effects, *Dams effects, *Reservoirs, *Ice cover, *Temperature effects, Wind, Water temperature, Ust'-Ilim Hydroelectric Station.

The ice and thermal regimes of a river change substantially with the construction of hydrostations due to a change in the discharges and temperature of the water in the lower pool. Observations of such changes were made at the Ust'-Ilim hydrostation and the effects on the region of construction of the fourth reach of the Angara cascade of hydrostations, the Boguchany, being constructed 386 km downstream of the Ust'-Ilim. Analysis of freeze-up data from the reservoir suggests that for equal or close air temperatures in the case of a greater wind speed or for equal or close wind speeds in the case of a higher air temperature, freeze-up occurs later and at a lower water temperature. In any case the longer the reservoir is subjected to the effect of wind in the prefreeze-up period, the lower will be the water temperature when freeze-up occurs. The maximum thickness of the ice cover on the reservoir is in March-April and is 0.90-1.10m. The maximum value of snow cover on the ice of 0.4-0.5m. Melting of the snow occurs by the end of April, in connection with which the surface water layers under the ice are heated more intensely and the thickness of the ice decreases. Break up occurs from the middle to the end of May. With increasing distance from the dam the water cools in the fall-winter period under the effect of meteorological conditions. Data do not suggest that there should be any substantial ice dams nor considerable rises of the level in the lower pool of the Ust'-Ilim hydrostation due to the presence of the hydrostation itself. (Baker-IVI)
W83-02297

ACCUMULATION OF SELECTED TRACE METALS IN SOILS OF URBAN RUNOFF DETENTION BASINS,
Oklahoma State Univ., Stillwater. Dept. of Forestry.
For primary bibliographic entry see Field 5B.
W84-02158

EVALUATION OF POTENTIAL WATER QUALITY PROBLEMS ASSOCIATED WITH HIGHWAY EXCAVATION AND FILL,
Texas Tech Univ., Lubbock. Water Resources Center.
G. F. Lee, and R. A. Jones.
Transporation Research Record, No. 892, p 2-8, 1983. 14 Ref.

Descriptors: *Environmental effects, *Highways, *Construction, Water quality control, Standards, Fill materials, Leachates, Testing procedures.

The excavation and disposal of materials and the use of fill materials in highway construction are potential threats to water quality. To provide guidance for the detection of potential problems from this source, the Environmental Protection Agency (EPA) published its Guidelines for Specification of Disposal Sites for Dredged and Fill Material in the Federal Register (December 24, 1980). The approaches that have been recommended for use in evaluating fill material for for environmental impact and also the approaches that should be followed for making such evaluations are discussed. Outlined is a water quality hazard assessment approach for evaluating the potential significance of contaminants associated with fill material derived from highway excavation and filling, which will promote technically valid, cost-effective, yet environmentally protective evaluation and control of excavation and fill materials associated with highway construction. (Baker-IVI)
W84-02216

QUALITY OF SEEPAGE AND LEACHATE FROM MINE AND MILL WASTES AND CONTROL OF ITS EFFECTS,
For primary bibliographic entry see Field 5B.
W84-02217

COMPARISON OF PREDICTION METHODS FOR SOIL EROSION FROM HIGHWAY CONSTRUCTION SITES,
A. C. Miller, W. J. Veon, and R. A. Chadderton.
Transportation Research Record, No. 896, p 33-39, 1983. 1 Fig, 1 Tab, 10 Ref.

Descriptors: *Highway construction, *Soil erosion, Erosion control, Mathematical studies, Design criteria, Environmental effects, Pennsylvania.

Six existing equations used by engineers to predict soil loss from highway construction sites were compared with a seventh method developed with data gathered from three highway construction sites in Pennsylvania. The accuracy of all the equations is illustrated in tabular form through the use of the average error prediction. The smallest average error is 119% and the largest is more than 600%. The significance of these errors depends on how the result is intended to be used. So long as the user is aware of the possible errors and the limits of the methods, the answers provided will be useful. A newly developed rational method provid-

ed to be the most error free. This rational model was composed of a combination of factors that represented the effects of various physical properties and hydrologic phenomena with regard to the soil erosion process and that together seemed to explain the process most reasonably. Each of the other six methods was deficient in one or more of the parameters considered to be significant. (Baker-IVI)
W84-02224

EFFECTS OF DREDGED HIGHWAY CONSTRUCTION ON WATER QUALITY IN A LOUISIANA WETLAND,
G. H. Cramer, II, and W. C. Hopkins, Jr.
Transportation Research Record, No. 896, p 47-51, 1983. 1 Fig, 1 Tab, 4 Ref.

Descriptors: *Highway effects, *Water quality control, Turbidity, Color, *Wetlands, Water quality, Environmental effects, Louisiana.

A research effort to determine, by physical and chemical means, the effect of current bridged highway construction techniques on water quality in a wetland is summarized. Selected water-quality parameters were monitored before, during, and after construction activities. Turbidity and color increased during construction and gradually returned to the preconstruction ambient in areas where construction was completed. Other parameters also followed this trend, but these changes were not as directly related to the construction activities as were turbidity and color. Elevated highway construction with environmental controls had minimal effects on the quality of the surrounding water. Local isolated activities other than highway construction produced more severe and longer-lasting effects on water quality. The information obtained may be useful in predicting the degree and duration of impacts of future construction projects on wetland environments. (Baker-IVI)
W84-02226

FIELD INSTRUMENTATION FOR MONITORING WATER-QUALITY EFFECTS OF STORMWATER RUNOFF FROM HIGHWAYS,
T. V. Dupuis, and B. N. Lord.
Transporation Research Record No. 896, p 55-60, 1983. 8 Fig, 7 Ref.

Descriptors: *Highway effects, *Storm runoff, *Monitoring, Water quality, Storm water, Hydrocarbons, Metals, Water pollution sources.

Storm-water runoff from operating highways can carry considerable quantities of pollutants, especially petroleum hydrocarbons and solids and metals, into the nation's receiving waters. The Federal Highway Administration, charged with the responsibility of protecting the environment from pollution from highway sources, has approached the problem in a multiphase research effort. The objective of the first phase was to identify and quantify the constituents of highway runoff. The next phase sought to identify sources and migration paths of these pollutants from the highways to receiving waters. The third phase, currently in progress, is analyzing actual impacts of highway runoff on receiving water. A wide variety of instrumentation has been used in the field monitoring portions of the investigation. Physical, chemical, and biological characterizations have been made. A general description of the types of equipment used in all three phases of the research program is presented. Special instrumentation and tests for source and migration studies include saltation catchers, zero-tension lysimeters, and sweeping and flushing. Saltation catchers were designed to capture saltating (moving by a series of jumps) particles form roadway surfaces. Zero-tension lysimeters measure groundwater percolation out of the major rooting zone. Sweeping and flushing studies were performed to quantify the accumultion and distribution of pollutants on the highway surface. (Moore-IVI)
W84-02228

LIFE HISTORY AND DISTRIBUTION OF THE ROANOKE BASS AMBLOPLITES CAVIFRONS COPE, IN VIRGINIA,
Virginia Commonwealth Univ., Richmond. Dept. of Biology.
For primary bibliographic entry see Field 2H.
W84-02378

7. RESOURCES DATA

7A. Network Design

EFFECT OF SAMPLING UNCERTAINTY AND SPATIAL CORRELATION ON AN EMPIRICIAL BAYES PROCEDURE FOR COMBINING SITE AND REGIONAL INFORMATION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
G. Kuczera.
Journal of Hydrology, Vol. 65, No. 4, p 373-398, September, 1983. 5 Fig, 5 Tab, 20 Ref.

Descriptors: *Sampling, *Probabilistic process, Mathematical studies, Model studies, Spatial distribution, Hydrologic models.

The effect of sampling uncertainty and spatial correlation on the pooling of site and regional information is studied in the context of the empirical Bayes (EB) normal probability model, chosen because of its simplicity and generality. Because the EB model parameters must be evaluated from observed hydrologic data they are subject to uncertainty which can be considerable when samples are small and inter-site correlation exists. The procedures developed enable one to assess approximately the effect of uncertainty in these parameters. Hence, the gains that pooled inference can make over site or regional inference can be realistically evaluated and also the cases for which pooling of information is counteproductive can be identified. While the EB model assumes the sampling distribution and superpopulation are normally distributed, the results can be usefully employed in non-normal situations whenever a quadratic loss criterion is acceptable. In such instances, the EB procedure for pooling site and regional information is the best available one for the class of linear procedures with its risk being given by the pooled variance. (Baker-IVI)
W84-02457

7B. Data Acquisition

APPARATUS FOR SAMPLING OF STREAMS FOR CHEMICAL QUALITY AND SEDIMENT,
Jonkershoek Forestry Research Station, Stellenbosch (South Africa). Dept. of Environmental Affairs.
D. B. Van Wyk.
Water South Africa, Vol. 9, No. 3, p 88-92, July, 1983. 4 Fig, 2 Tab, 7 Ref.

Descriptors: *Sampling, *Streams, *Storm runoff, Monitoring, Measuring instruments, Costs, Automation, Bed load.

An apparatus was designed to automatically collect samples from streams during spates. The system enables stage samples to be taken during both the rise and recession of spates and functions on natural hydraulic pressures created by changes in stream level. A system for the measurement of bed load deposits that has been in use since 1978, is also described. These techniques have proved effective and cost is low when compared with other equipment marketed for similar purposes. The sampling record shows a success rate of 95% over two rainy seasons in the Western Cape (South Africa). The success/failure rate is reported for 5 catchments where the apparatus was well maintained. Blockages caused by debris, and air leaks are the only factors that cause sampling failure. (Baker-IVI)
W84-02308

TELEMETRY FOR MONITORING AND CONTROLLING WASTEWATER COLLECTION SYSTEMS,
Johnson (Bernard), Inc., Houston, TX.
M. A. Vivona, and R. W. Graupmann.
Public Works, Vol. 114, No. 6, p 69-73, June, 1983. 3 Fig.

Descriptors: *Telemetry, *Monitoring, Wastewater collection, Remote sensing, Management.

The three principle methods of telemetry communications are telephone lines, radio, and microwave, each with its advantages and disadvantages. Telemetry systems have evolved from simple DC systems to tone systems to digital-based systems. Digital systems are economical for applications with as few as three of four signals per remote station. In applications requiring remote control as well as monitoring, digital technology is mandatory to provide the necessary level of security. Only a digital system offers the error checking and multiple transmission capabilities necessary for control system integrity. Microcomputers based systems, complete with CRT's and printers are available for relatively low capital investment. More sophisticated systems to regulate sewer flow are feasible and cost effective. (Baker-IVI)
W84-02359

DIRECT METHOD FOR FOREST TRANSPIRATION MEASUREMENT,
Stavebni Geologie, Prague (Czechoslovakia).
For primary bibliographic entry see Field 2D.
W84-02461

MICROPROCESSOR-CONTROLLED PRECIPITATION DATA COLLECTION SYSTEM,
Idaho Agricultural Experiment Station, Moscow.
M. D. Burgess, and C. L. Hanson.
Journal of Hydrology, Vol. 66, No. 1-4, p 369-374, October, 1983. 2 Fig.

Descriptors: *Microprocessors, *Precipitation, *Meteorological data collection, Data storage and retrieval, Data acquisition, Rainfall, Computers.

A microprocessor system was developed that uses a removable memory module for precipitation gage data storage and retrieval. The system can be used in remote locations as the circuitry draws very little power. Precipitation data are entered directly from the removable memory module into a computer for data storage and analysis. This eliminates the need for recorder charts and manual data entry into a computer system. Detailed descriptions are offered of the precipitation gage, A/D converter, digital clock, four-digit display, I/O control logic, state code logic, microprocessor, removable memory module, and readout system. Storm event records were plotted from this system and a nearby standard weighing-recording precipitation gage to determine how well the record from this system compared with the catch from the standard weighing-recording gage. Analysis of the plots showed that the same amount of precipitation was recorded at the same time by the two gaging systems. (Baker-IVI)
W84-02476

7C. Evaluation, Processing and Publication

COMPUTER IMPROVES COMPOSITES,
South Dakota School of Mines and Technology, Rapid City.
L. L. Harms, and H. Smith, Jr.
Water Engineering and Management, Vol. 130, No. 12, p 39-40, November, 1983. 3 Fig.

Descriptors: *Computers, *Sample preparation, Water sampling, Hydrographs, Composite samples, Wastewater sampling.

A computer program has been developed to aid in determining the correct aliquots of a composite sample so that the sample will reflect the proper

proportions of various discrete water or wastewater samples. A flowchart of Program COMP4 is displayed. The program is designed to accept up to 100 data points on a hydrograph. Input data are time, flow, sample numbers, empty container weights, and container weights after sampling. A hydrograph from an urban watershed from which four discrete samples were collected is shown. (Baker-IVI)
W84-02370

8. ENGINEERING WORKS

8A. Structures

SOME RESULTS OF GENERALIZING AND ANALYZING THE EXPERIENCE OF ON-SITE OBSERVATIONS OF THE STATIC OF CONCRETE DAMS,
A. N. Marchuk.
Hydrotechnical Construction, Vol. 17, No. 2, p 68-70, February, 1983. 2 Tab, 4 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 16-18, February, 1983.

Descriptors: *Concrete dams, *Dam construction, Safety monitoring, Construction, Design criteria, Costs, Stress, Deformation, Rock mechanics, USSR.

Data was gathered from on-site observations made during the last 20 years on 15 large dams in the USSR with an effort toward establishing a further improvement in the design of concrete dams and reducing their consumption of materials and cost. Owing to the absence of a unified method of siting and assembling the instruments, and processing and interrelating their readings and to the lack of a system of centralized collection of report data on observations of structures of the same type, generalization and analysis of the data was difficult. Repeated checks of the fulfillment of the conditions of invariance of stresses and measurements of deformations indicates a good degree of accuracy and reliability of on-site observations made by means of embedded string-type transducers. There was a low accuracy of string-type instruments in the range of small deformations and there is imperfection of the method for converting strains to stresses. Geodetic observations in recent years at large hydrostations have recorded substantial deformations of rocks at dam sites, with the formation of a settlement crater extending up to 3 km downstream, convergence of the banks, and sometimes movements of the bank slopes, suggesting the presence of a three-dimensional state of streams of the dams. The application of solutions of the two-dimensional problem to such dams is therefore quite conditional and can lead to inaccurate results. The stress state of the profiles of gravity and buttress dams during permanent operation is characterized by ubiquitous compression formed mainly under the effect of the dead weight and changes in the temperature of the air, concrete, and water in the upper part of the reservoir. The imperfection of the available instruments does not permit checking by direct measurement the design assumptions about the extent of certain main loads acting on dams. In gravity and buttress dams there occurs a low level of use of the strength properties of the rock foundations, concrete and reinforcing steel bars. The organization of on-site observations on hydraulic structures requires a radical improvement for obtaining a maximum cost effectiveness from eliminating the excess safety factors in the methods of calculating and designing dams. (Baker-IVI)
W83-02294

CALCULATION OF HYDRAULIC ELEMENTS OF STABLE SECTIONS OF LARGE CANALS IN FINE SANDS,
V. A. Skryl'nikov.
Hydrotechnical Construction, Vol. 17, No. 2, p 90-95, February, 1983. 1 Fig, 1 Tab, 12 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo No. 2, p 32-34, February, 1983.

Descriptors: *Sand, *Stability analysis, *Canal construction, Construction, Canals, Canal design, Design criteria, Flow velocity, Soil properties, Flow.

In order to calculate hydraulic elements of stable sections of large canals in fine sands the cross section of the large canal should have not only the necessary capacity, but also a fully determined planar stability both longitudinal and transverse. Longitudinal stability means a constancy of the planar position of the channel line, rectilinear or curvilinear. For conditions of canals it is expedient to distinguish the following types of longitudinal stability: static, achieved at a flow velocity corresponding to the noneroding velocity; transitional (from static to dynamic) or quasidynamic is characterized by the start of development of bed formations in the form of small and large ripples and preparation of the flow for transport of all particles of the bottom sediments; dynamic for a straight channel corresponding to hydraulic elements for which in the canal a certain amount of bottom sediment is transported in the form of large ripples and small ridges, preserving the rectilinearity of the flow in plan; and dynamic for a sinuous channel composed of cohesionless oils corresponding to hydraulic elements for which the flow in plan takes on a stable curvilinear shape, also transporting a certain amount of sediment as ridges. If the banks are composed of cohesive solid, then the rectilinearity of the channel in plan can be preserved due to nonerodibility of the banks, although the channel line will be curved relative to the axis of the channel of the canal. (Baker-IVI)
W83-02298

DESIGN OF MODELS FOR INVESTIGATING DYNAMIC PHENOMENA IN MECHANICAL EQUIPMENT OF HIGH-HEAD SPILLWAYS,
G. A. Chepaikin.
Hydrotechnical Construction, Vol. 17, No. 2, p 96-99, February, 1983. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 35-37, February, 1983.

Descriptors: *Spillways, *Design criteria, Model studies, Construction equipment, Mechanical equipment, Gates, Hydraulic models.

The interrelation of hydrodynamic phenomena in a spillway and in its metal linings, gates, and lifting mechanisms compels regarding such a spillway with gates and mechanisms as a single hydrodynamic system. Thus a model of the system must completely reproduce all essential structural members, loads acting on the members, and reactions of the members to these loads. A model for hydrodynamic investigations should in all details be geometrically, kinematically and dynamically similar to the prototype structure. This means that the design of the model should duplicate the calculation and design of the prototype structure. A model with its gauges serves for measuring various mechanical quantities characterizing the hydrodynamic proceses occurring in it. When designing and fabricating the model it is necessary to treat it as a measuring instrument, assessing and establishing the possibilities and errors of operation of each component. Since a single law of modeling for all phenomena does not exist, it is necessary to select a law or group of laws which is uniquely applicable to the maximum number of phenomena and to make the remaining phenomena obey this law by imposing special requirements on the design of the model. Such a most general modeling law is the condition of the joint similarity of the geometric dimensions of the structures and water depths in the pools of the prototype and model (the Froude similarity condition). Similarity should be maintained in all dimensions, both overall for the spillway and gates in detail as in the dimensions of individual sections of gates and their articulated joints, in the dimensions of the beams, plates, suspension, running gear, and sealing devices, in the gaps between the gate and embedded parts, in the bearings, and in the roughness of the surfaces exposed to the flow. It is necessary to maintain similarity of the masses and rigidities (deformations) of the structural members and also similarity of the forces acting on the mechanical system, including external forces and mechanical frictional forces. All dimensions must be examined not only in the design version but sometimes also for possible deviations in construction. (Baker-IVI)
W83-02299

CONCERNING THE USE OF A RELIABILITY COEFFICIENT IN CONSTRUCTION SPECIFICATIONS AND REGULATIONS AND THE CASUAL SEEPAGE STRENGTH OF FOUNDATIONS OF EARTH STRUCTURES,
S. M. Slisskii.
Hydrotechnical Construction, Vol. 17, No. 2, p 106-107, February, 1983. 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 41-42, February, 1983.

Descriptors: *Hydraulic structures, *Safety, Construction, Regulations, Dams, Earth dams, Seepage, Reliability, Foundations.

The problem of calculating the reliability of hydraulic structures is complex and the development of acceptable generally recognized calculation methods requires considerable effort. When designing hydraulic structures the possibility of operating with quantitative reliability criteria at the same level as is found in a number of other areas of engineering is at present inaccessible for hydraulic engineering. Of particular importance is the problem of increasing the reliability of dams by taking into account chance factors such as the presence of concentrated seepage paths at the base of a structure or in the body of earth dams as a consequence of knowingly inferior performance of the works or as a result of errors in evaluating the properties of the nonrock earth foundation. Statistical data on constructed structures are used for determining the length of the seepage contour of concrete dams on earth foundations and the necessary certain average seepage path in the body of an earth dam. The reliability coefficient as used in the SNiPs (reliability of structures in the construction specifications and regulations) in no way gives an idea about reliability as a probabilistic quantity and in essence remains a factor of safety, which is a quantitative expression of the predominance of the generalized bearing capacity of the structure, structural member, and foundation over the generalized acting forces. The matter is not changed by the probabilistic determination of a certain type of loads. The term reliability coefficient in the SNiPs for hydraulic structures should be replaced by safety factor. The question of calculating earth foundations for casual seepage strength ought to be reexamined and this method of calculating be used only for making preliminary approximate decisions. (Baker-IVI)
W83-02301

INVESTIGATIONS OF THE KURPSAI DAM ON THE BASIS OF A NUMERICAL SOLUTION OF THE THREE-DIMENSIONAL PROBLEM OF ELASTICITY THEORY,
K. I. Dzyuba, and B. V. Fradkin.
Hydrotechnical Construction, Vol. 17, No. 2, p 71-80, February, 1983. 9 Fig, 10 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 19-25, February, 1983.

Descriptors: *Elastic properties, *Concrete construction, *Gravity dams, *Mathematical studies, Theoretical analysis, Dams, Kurpsai Dam, Construction, Engineering, Concrete dams, Rock mechanics.

Progress made in the development of computing machinery and numerical methods of mechanics of solid deformable bodies has made it possible in a study of the Kurpsai Dam to proceed to a determination of the three dimensional work of the structure in an improved formulation. The following tasks were undertaken during the investigation: to refine the three-dimensional stress-strain state of the structure, particularly in the zone of contact with the foundation where tensile stresses acting from the upstream face perpendicular to the contact were noted; to examine various combinations of the external actions, including the seismic load, determined, according to the standard spectral method of construction specifications and regulations, by determining the frequencies and modes of

natural vibrations from the solution of two-dimensional problems of elasticity theory for cross sections of the dam; and to analyze the static behavior of the structure with consideration of possible opening of the vertical section joints. The stress-strain state of the concrete dam of the Kurpsai Hydrostation was determined by the finite-element method on the basis of solving the three-dimensional problem of elasticity theory modeling the dam and part of the rock mass surrounding it. The calculation was performed for the right bank part of the dam on the assumption of symmetry of the structure. The PROZA computer complex was used to solve the three-dimensional problem. Opening of the section joints is a possible consequence of gradual cooling of the concrete masonry. Careful on-site observations of the state of the joints is needed for their timely grouting. The numerical model of the structure developed during conduction of the works presented can be used for analyzing the data of on-site observations. (Baker-IVI)
W84-02295

CLEANING AND LINING OLD WATER MAINS SAVES MILLIONS FOR MASSACHUSETTS COMMUNITY,
Camp, Dresser and McKee, Inc., Boston, MA.
R. Cutone.
Public Works, Vol. 114, No. 3, p 70-71, 96, March, 1983. 1 Fig, 1 Tab.

Descriptors: *Water mains, *Linings, Maintenance, Water conveyance, Pipelines, Costs, *Massachusetts, *New Bedford.

Maintaining adequate water pressure during daily peak demand conditions is a matter for concern in any distribution system. New Bedford, an old seaport community 60 miles south of Boston, is a city of about 100,000 supporting many industrial and commercial enterprises. The public water system has been in existence since 1869 while the limits of the system as it exists today have remained unchanged since the 1930s. An annual system of cleaning and cement lining of unlined cast-iron water mains with the ultimate goal of having cement-lined pipes throughout the system was begun in the 1970's. As a measure of the over $4-million savings the city has seen, the following analysis was made. Using the actual costs incurred by the city for each year's program and estimates of costs for construction of new cement lined ductile iron pipe of comparable diameters and lengths, the net savings to New Bedford was developed. Using the same information, a ratio of cleaning and lining costs versus cost to construct new mains was determined to be 2.74. (Baker-IVI)
W84-02352

8B. Hydraulics

PREDICTION OF CHANNEL BED GRADE CHANGES AT HIGHWAY STREAM CROSSINGS,
S. A. Brown.
Transportation Research Record, No. 896, p 1-7, 1983. 2 Fig, 2 Tab, 31 Ref.

Descriptors: *Bridges, *Grading, Mathematical models, Channels, Highways, Model studies, Aggradation, Scouring.

Changes in channel bed-level elevation associated with channel aggradation and degradation have been found to be a significant cause of hydraulic problems at bridges. Numerous techniques for evaluating the impact of these grade changes, from simple, qualitative geomorphic principles to complex, fully developed, computer models, are available in the literature. These techniques represent a wide range of levels of analysis data needs, difficulty of application, time requirements, and costs. The number of techniques available and the variety in their levels of accuracy emphasize the need to base gradechange predictions on more than one technique or model. An appropriate procedure starts with general observations and the evaluation of geomorphic principles and relations to establish the cause and direction of the change and is then built on by applying some of the simpler quantitative techniques. From this base, one or more of the levels of mathematical modeling can be applied. The level of sophistication used in the modeling process should be based on the physical processes causing the grade change, the economic importance of the particular crossing, and available time, manpower, and financial resources. (Author's abstract)
W84-02221

STREAM CHANNEL GRADE CHANGES AND THEIR EFFECTS ON HIGHWAY CROSSINGS,
S. A. Gilje.
Transportation Research Record, No. 896, p 7-10, 1983. 6 Fig, 12 Ref.

Descriptors: *Aggradation, *Degradation, *Channels, *Streambed, *Highway effects, *Bridges, Sedimentation, Sediment transport, Geomorphology, Rivers, Streams.

Stream channel degradation and aggradation are significant hydraulic problems at river crossings. Degradation is lowering of the streambed, independent of scour caused by obstructions or constructions. Rapid or long-term degradation is usually due to a significant change in normal sediment-transport relations. Aggradation is stream infilling and occurs when more sediment is supplied to a stream than the stream is capable of transporting. Problems caused by stream degradation are far more common than those caused by aggradation. If actions are to be taken to protect a highway crossing against grade changes, early recognition of these hazards is imperative. Techniques for determining whether a crossing is experiencing degradation or aggradation are observation of stream characteristics (geomorphology), anticipation of gradation changes based on watershed activities, and measurement of pertinent stream dimensions. Streams in areas of high sediment yield are most prone to grade changes. Severe grade changes are often due to human intervention in natural stream processes. The problems associated with degradation and aggradation warrant special attention because protective measures effective against local hydraulic hazards are ineffective for protection against grade changes. (Author's abstract)
W84-02229

NONSTATIONARY CHANNEL DEFORMATIONS NEAR OBSTACLES,
Institute of Railroad Transportation Engineers, Moscow (USSR).
Yu. L. Peich.
Water Resources, Vol. 10, No. 1, p 66-70, January-February, 1983. 2 Fig, 7 Ref. Translated from Vodnye Resursy, No. 1, p 108-112, January-February, 1983.

Descriptors: *Channels, *Flow, *Channel deformation, Mathematical studies, Model studies, Hydraulic structures, Construction, Scour, Flow around objects.

Local deformations of a channel due to changes in the kinematic structure to the flow near an obstacle have a considerable effect on the operating conditions of hydraulic structures. An attempt is made to further develop the relations of the instantaneous bed-load discharge in the scour zone on the depth of local channel deformations and the exponential dependence of the bed load discharge on time by determining the appropriate dependences of the maximum discharge in the scour pocket and sediment discharge gradient on the hydraulic parameters of the flow. (Baker-IVI)
W84-02346

8C. Hydraulic Machinery

METHODS AND MEANS OF AUTOMATED MONITORING OF THE STATE OF HYDRAULIC STRUCTURES DURING THEIR OPERATION,
D. B. Radkevich.
Hydrotechnical Construction, Vol. 17, No. 2, p 59-67, February, 1983. 4 Fig, 1 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 11-16, February, 1983.

Descriptors: *Monitoring, *Hydraulic structures, *Electrical equipment, Mechanical equipment, Automation, Powerplants, Computers.

A number of string transducers have been developed and are being manufactured for prompt remote monitoring of the state of structures and automation of monitoring operations. String transducers are finding their most effective use when measuring settlement, horizontal displacement, levels of the depression surface, discharges in collector drains, and deformation of the expansion, settlement, and horizontal joints in structures. Automation of these measurements substantially simplifies the use of computers for data processing and gives the operating personnel prompt information about the state of structures and their foundation. The transducers, together with traditional nonelectrical means of monitoring the state of structure, form remote measuring systems. The systems monitoring the state of the structures can be of three types, differing in level of automation: remote systems with cables leading from the transducers to the KP-24 cummulator switches and with measurement of the signals by means of the PTsP-1 portable digital periodometer; centralized systems with automated collection and digital recording of the measurement data by means of teletypewriter tape punch; and automated information measuring systems based on control computer complexes performing real-time data processing. Remote monitoring of the settlement of structures and foundations and observations of deflections or reinforced concrete structural members are accomplished by means of a hydrostatic leveling system constructed with the use of type PUZhS liquid-level transducers. The mass production of string transducers makes it possible to equip large operating hydrostations with them and to envisage the creation of automated systems for monitoring structures during operation when designing new facilities. (Baker-IVI)
W83-02293

8D. Soil Mechanics

MODELING IN TESTS OF COARSE-FRAGMENTAL SOIL OF THE ZARAMAG DAM,
O. A. Pakhomov.
Hydrotechnical Construction, Vol. 17, No. 2, p 80-84, February, 1983. 3 Fig, 2 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 25-28, February, 1983.

Descriptors: *Dam construction, *Soil properties, Model studies, Construction, Design criteria, Petrography, Mineralogy, Rock fill, Zaramag Hydroelectic Station.

A correct determination of the characteristics of gravel-pebble mixtures, rock mass, and rock fill is exceptionally important in the construction of earth structures for large power installations and the preparation of foundations for power units of thermal and nuclear power stations as these characteristics affect the selection of an economical design for the structure, the effective technology of its construction and the duration of trouble-free operation of the structure. An example is offered of a modeling method used when substantiating the design characteristics of coarse-fragmental material for the dam at the Zaramag hydroelectric station. The given conditions of modeling when testing coarse-fragmental soils makes it possible to cover a wide range of prototype particle-size distributions of construction soils practically without limiting the content of fine and coarse-grained fractions in them. When testing prototype soils or their model mixtures it is recommended to determine the allowable size of the fractions in relation to the size of the laboratory device and the granularity of the tested material. The modeling conditions call for composing several model mixtures, compaction of the samples to the same projected relative density, laboratory or field testing, and conversion from the results obtained to the characteristics of the coarse fragmental soils of the prototype composition. The most important distinctive feature of the given

model method is the integral consideration of the significant factors affecting the physical and mechanical characteristics being determined. Such fractors include petrographic and mineralogical composition, specific weight, strength, shape and size of the particles, surface roughness and others. This increases the accuracy of the test results compared to methods which specify an investigation of one model mixture and which are forced to take into account and aforementioned factors by various hypotheses and assumptions. (Baker-IVI)
W83-02296

CALCULATION OF HYDRAULIC ELEMENTS OF STABLE SECTIONS OF LARGE CANALS IN FINE SANDS,
For primary bibliographic entry see Field 8A.
W83-02298

CONCERNING THE USE OF A RELIABILITY COEFFICIENT IN CONSTRUCTION SPECIFICATIONS AND REGULATIONS AND THE CASUAL SEEPAGE STRENGTH OF FOUNDATIONS OF EARTH STRUCTURES,
For primary bibliographic entry see Field 8A.
W83-02301

COMPACTION PROCEDURES, SPECIFICATIONS, AND CONTROL CONSIDERATIONS,
E. T. Selig.
Transportation Research Record, No. 897, p 1-8, 1983. 4 Fig, 24 Ref.

Descriptors: *Soil compaction, *Soil mechanics, *Earthworks, Construction, Compaction tests, Soil density, Soil water.

Compaction is the process of soil densification by mechanical manipulation. The reason for compacting is to improve soil properties such as increasing strength, decreasing compressibility, decreasing permeability, and reducing swelling and shrinkage. Factors that influence field compaction results include soil type, method of preparation, uniformity of procedures, environmental influences, roller type, compactive effort, lift thickness, underlying layer, and rate of compaction. Variability of density from point to point in the field is sufficiently large that compliance of 100% of compaction tests with a specified compaction requirement is unfeasible and unreasonable to expect. Variability is significant, with a typical standard deviation of density scatter being 4 to 6 lb/ft. Modification of moisture content is rarely required for construction unless density results are unsatisfactory. As normally practiced, testing is insufficient for reliable judging of compaction. (Moore-IVI)
W84-02230

EMBANKMENT COMPACTION AND QUALITY CONTROL AT JAMES BAY HYDROELECTRIC DEVELOPMENT,
J.-J. Pare, B. Boncompain, J.-M. Konrad, and N. S. Verma.
Transportation Research Record, No. 897, p 8-15, 1983. 10 Fig, 3 Tab, 5 Ref.

Descriptors: *Embankments, *Dykes, *Soil compaction, Earthworks, Earth dams, Rockfill dams, Dam construction, Quality control, La Grande Complex, James Bay, Quebec.

Construction of 220 dams and dykes at the La Grande Complex, James Bay (Quebec) hydroelectric development involves several types of materials (till, sand and gravel, and rockfill) and construction procedures and equipment that must yield embankment zones of desired characteristics. Experience and design requirements, as well as the schedules, economic, and climatic restraints, have led to a general standarizat. n of the specified material placement techniques and conditions. The specification have developed along the following lines: designation of borrow areas; product specifications for materials; and procedure specification for fill placement. Quality control includes both visual inspection and laboratory testing of materials at the borrow areas as well as on the fill. Visual inspection to control material, equipment, procedure, and product is of utmost importance because it permits a repid and general evaluation of the quality of work, particularly of the embankment homogeneity. Three categories of tests are performed: grain-size analyses and water content determination (carried out at a rate of about 1/5000 cu m or 1/day and 1/1000 cu m, respectively) for a quick verification of the conformity of materials to specifications; measurement of field densities and reference or target densities on a regular basis with a frequency of about 1/5000 cu m or 1/day to monitor uniformity of fill placement; and determination of permeability, comperssibility, and strength characteristics of the embankment materials, carried out annually to verify the conformity of the material properties with the design assumptions. Typical properties of the embankment materials based on extensive tests carried out on 160 Mm3 of materials are included. (Moore-IVI)
W84-02231

COMPACTION PRACTICE FOR DAM CORES AT HYDRO-QUEBEC,
O. Dascal.
Transportation Research Record, No. 897, p 60-71, 1983. 15 Fig, 1 Tab, 3 Ref.

Descriptors: *Soil compaction, *Glacial till, Earth dams, Rockfill dams, Quebec, Clay, Water content, Soil water, Construction, Dykes, Dam cores.

Glacial till is used mainly as an impervious material in earth and rockfill dams built in Quebec. It is, in general, a well-graded mixture of sand, silt, and gravel, with 25-80% passing the no. 200 sieve and a natural water content at or above optimum (Proctor standard). Its natural water content, together with its very high sensitivity to atmospheric humidity, strongly influence the choice of compaction equipment, compaction procedure, and time schedule. Hydro-Quebec's experience with this type of material, including choice of the compaction equipment, establishment of the compaction procedure, pretreatment of the borrow pit material, as well as the results and performances obtained at various sites are presented, based on three case histories. The first project used a till that had a natural water content at or slightly above its optimum, and hence presented no problem of placement or compaction. In the second project, the use of a till that had a natural water content substantially higher than optimum created a set of difficult problems and necessitated the adoption of new solutions. A third example illustrates the use of a highly sensitive marine clay as core material, its placement, and compaction problems experienced during the construction of an earth-fill dike located in the St. Lawrence valley. (Moore-IVI)
W84-02232

8E. Rock Mechanics and Geology

SOME RESULTS OF GENERALIZING AND ANALYZING THE EXPERIENCE OF ON-SITE OBSERVATIONS OF THE STATIC OF CONCRETE DAMS,
For primary bibliographic entry see Field 8A.
W83-02294

PREDICTION OF GAS SHOWS IN UNDERGROUND WORKINGS (EXEMPLIFIED BY THE NUREK HYDROELECTRIC STATION),
N. F. Lomonosov, and L. A. Mikhaleva.
Hydrotechnical Construction, Vol. 17, No. 2, p 100-102, February, 1983. 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 37-38, February, 1983.

Descriptors: *Hazards, *Tunneling, *Gases, Construction, Tunnel construction, Tunnels, Safety, Earthquakes.

The liberation of gas from rocks in underground workings complicates tunnel operations to varying degrees. The low degree of reliability found in predicting where gas is and the characteristics of the gas is due both to the complex character of the distribution of gases in rocks and to the insufficient study of gas. Analyses of gas encounters suggest that weak gas shows in underground workings can create local gas pollution exceeding the permissible levels, particularly during earthquakes. With existing survey methods the complex distribution of gases in rocks and their variable composition and flow rates preclude their reliable prediction. To ensure the safety of tunneling operations it is necessary to systematically monitor the composition of the mine atmosphere with consideration of possible gas reservoirs (especially of the fissure-vein type), even in those cases when according to the survey data there is no information on expected gas shows. During engineering-geological surveys and documentation of underground working it is necessary to take into account, in the working hypothesis of the geological structure of the rock masses, the broad possibility of the penetration of deep gases with harmful components to various levels, right up to the surface. A comprehensive study of gas shows detected in tunnels is needed in order to create reliable methods for predicting these shows and for purposeful monitoring of the mine atmosphere. (Baker-IVI)
W83-02300

IDENTIFICATION OF SOURCE MATERIALS FOR ACID LEACHATES IN MARYLAND COASTAL PLAIN,
For primary bibliographic entry see Field 5B.
W84-02219

CHEMICAL COMPOSITION OF NATURAL WATERS AND ROCK WEATHERING IN THE IZU PENINSULA AREA AS AN INDEX TO EARTHQUAKE-CAUSED LANDSLIDES,
Miyasaki Univ. (Japan). Dept. of Civil Engineering.
Y. Kitano, S. Nakamura, M. Takemura, and K. Majima.
Japanese Journal of Limnology, Vol. 44, No. 3, p 155-172, July, 1983. 9 Fig, 3 Tab, 11 Ref.

Descriptors: *Chemical composition, *Landslides, *Natural waters, *Izu Peninsula, *Japan, *Earthquakes, Rockslides, Rocks, Weathering, Limnology, Minerals, Carbonates, Sulfates.

The possibility that the chemical composition of natural water may be related to the occurrence of earthquakes is considered. Natural waters of the Izu Peninsula (Japan) area were used for the study. The natural waters in the southern part of the peninsula and in the Inatori area exhibited very high concentrations of dissolved constituents. These waters flow out through a fault. A calcium chloride type water was also found in Izu Peninsula in a typical fault area. No relationship was determined between earthquakes and the chemical composition of natural waters. However, from the chemical composition of natural waters, the amount of rock forming minerals chemically weathered and also the amount of clay minerals formed were estimated. The formation of clay minerals greatly decreases ground stability. The dissolution of silica has little influence as compared with the formation of clay minerals, but the carbonate dissolution has a significant role. The concentration of carbonates plus sulfates in the natural waters in Izu Peninsula may well indicate the degree of ground stability in the area and thereby predicts the size and extent of landslides. Estimation of the amounts of clay minerals formed and rock forming minerals weathered is thus valuable and useful for the prediction and prevention of earthquakes disasters. (Baker-IVI)
W84-02477

8F. Concrete

EXPERIENCE IN GROUTING CONCRETE UNDER CONDITIONS OF THE FAR NORTH,
Yu. D. Chertykov, and M. M. Dzhuraev.
Hydrotechnical Construction, Vol. 17, No. 2, p 108-111, February, 1983. 2 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 2, p 45-47, February, 1983.

Group 8F—Concrete

Descriptors: *Grouting, *Abutments, *Cold weather construction, *Concrete, Construction, Cold regions, Permeability, Drilling.

A new grouting technology was employed at a hydraulic structure located in the Far North, shortening the duration of the work considerably. Destruction of the concrete surface of abutments had occurred and seepage of water through the body of the abutments and around the embedded parts of the support contour of the gate was increasing. A number of research holes were planned for drilling over the entire height of the abutments to check the condition of the concrete masonry in the inner parts. These holes showed that the concrete was in unsatisfactory condition and its various areas had a different degree of preservation and permeability. In order to repair the structure it was decided to inject the entire mass of concrete into the abutments. Four rows of vertical holes were drilled so that they covered the concrete, especially in the upper part and edge regions of the abutments. Drilling of the holes and injection of the stabilizing slurries were carried out in three phases in descending 5-m zones at an injection pressure of 3-5 atm in the first zone and 8-10 atm in the subsequent ones. The applicability of the grouting and resin impregnation methods was established by hydraulic testing. It was decided to dispense with resin impregnation as a complex and labor intensive method of sealing concrete and to use only grouting. The following new technology was developed: to simultaneously drill holes of all phases to the complete design depth over the entire abutment, during drilling to carefully record the condition of the concrete on the basis of the rate of penetration, core recovery, its preservation and the consumption of water for flushing the holes. Hydraulic testing was carried out in all holes to determine the permeability of the concrete. All visible outflows of the water were eliminated by sealing with thick cement-sand mortar with the addition of sodium silicate. Before starting, steam from the works was fed for 1 hr into the hole through a pipe or hose lowered to the bottom of the hole. The cement slurry was prepared with warm water and bentonite in an amount of 5% of the weight of the cement was added to it to increase the stability of the slurry. Grouting began with the holes having minimum specific water absorption, gradually proceeding to holes with greater specific water adsorption. Holes with large adsorption of cement are left to settle then drilled out and grouted again. (Baker-IVI)
W83-02302

8G. Materials

CORROSION AND SCALE INHIBITORS FOR WATER DISTRIBUTION SYSTEMS,
Stearns and Wheeler, Cazenovia, NY.
For primary bibliographic entry see Field 5F.
W84-02361

VERSATILE ASPHALT: LAGOON AND RESERVOIR LINER,
National Asphalt Pavement Assoc., Riverdale, MD.
C. Crawford.
Water Engineering and Management, Vol. 13, No. 12, p 30 and 32-33, November, 1983. 2 Fig.

Descriptors: *Asphalt, *Linings, *Reservoir linings, Landfills, Reservoirs, Cement, Ponds, Lagoons, Retention ponds, Water storage.

The earliest known use of asphalt was to seal ponds and baths nearly 5000 years ago. Among the pond type appliactions of asphalt are: sewage lagoons, water storage reservoirs, landfill liners, brine lagoons, and retention ponds, all with the primary objective of retaining materials in storage and preventing seepage of the stored material into the soil groundwater system. No material found thus far can match asphalt tor its unique combination of the properties of stength, durability, flexibility, resistance to many hazardous materials and pollutants, and its impermeability. In landfills in Pennsylvania, hot mix asphalt has been used extensively as a liner for more than 10 years. The type of asphalt mix used is normally similar to a paving asphalt mix with 1/2 in. maximum size. The asphalt cement content is higher (perhaps 7-8% compared with about 55% for highway mixes) which renders the mix more workable, easier to compact on slopes and less permeable. A final seal of AC 20 grade asphalt cement applied at the rate of 0.25 gal/sq yd is recommended. (Baker-IVI)
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